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A REVIEW OF THE MARINE COTTID FISHES OF CALIFORNIA

By Rolf L. Bolin

Almost one tenth of the marine fishes known from California are members of the family Cottidae. Most of these are tide-pool or shallow-water species which frequently fall into the hands of ecologists, parasitologists, or other biologists who are not specialists in systematic ichthyology. Determinations, effected by such workers only after a laborious search for scattered but important items in an unfamiliar literature, are often inaccurate and considered as tentative by the determiners themselves. The present work is an attempt to remove, or at least to reduce materially, the feeling of doubt that has so often attended the identification of California cottids in the past.

In order to promote the primary purpose of the work as a handbook for the identification of specimens, and to confine it within reasonable limits, all discussions of phylogenetic patterns have been omitted and reserved for future publication in a separate series of papers. A number of genera have been expanded to include more species than is customary in current classifications of the Cottidae. Although this is done without explanation, it may be stated that the new arrangement establishes genera of more nearly equivalent differentiation than has hitherto been the case, while the use of numerous subgenera provides some indication of minor evolutionary groupings. No attempt has been made to distinguish between subspecies. Differentiation to this degree is usually of little interest except to systematic specialists. Those who would delve deeper into the problem are referred to the subspecific descriptions which are listed in the synonymies of *Clinocottus analis* and *Leptocottus armatus*, the two forms which have been subdivided. Finally, I have not endeavored to split the Cottidae into subfamilies. Most of the subfamilies so far introduced appear to be based upon insufficient grounds or upon a distribution of characters that does not follow major evolutionary lines. A correct allocation of all genera to their proper groups must await osteological work on several rare forms of which no material is at present available for dissection.

In using the present work it must be borne in mind that definite geographic limits have been set. While descriptions of species will probably fit material collected in any region, the diagnoses of larger categories which contain species not found in California may be misleading, and the keys will certainly prove to be entirely inadequate, if an attempt is made to apply them to cottids collected in other areas.

Specific descriptions have been based upon 50 specimens, if adequate material was available. They are, therefore, descriptions of species rather than of specimens. Except in the case of those species represented by one or a very few

specimens, new material should exceed the stated limits of variation but slightly and in only a very few characters. For ease in comparison, the descriptions conform to a uniform plan. Paragraphs, arranged in uniform order, cover the same subjects in all species, while throughout the work details are arranged in the same sequence. It should be noted that characters, no matter how minute, that are common to all species of a genus are treated in the generic description and are not repeated in the specific discussions.

The synonymic lists are not intended to provide a complete catalogue of the published references to each species. However, an attempt has been made to include the reference introducing each new name; at least one reference including a figure; the first reference listing records of capture from specific California localities; references giving the northern and southern extremes of the published range; and a reference to Jordan and Evermann's standard work, The Fishes of North and Middle America.

Measurements and counts presented in the descriptions were taken in a uniform manner. Straight-line measurements between selected points were recorded in tenths of millimeters and the permillage of the standard length and proportion to other measurements calculated mathematically. The initial values given in the text are the arithmetical means of all specimens measured; the values included in parentheses are the extremes. The standard length was measured from the tip of the snout (most anterior part of head) to the end of the hypural. The latter point, visible in some small semitransparent specimens, may be determined with fair accuracy in larger individuals by bending the caudal fin from side to side and noting the position of the abrupt wrinkle formed at the base of the rays. The length of the head was measured from the most distant point on the median line of the upper lip to the extreme posterior margin of the opercular membrane. It may be noted that the upper lip forms the most anterior part of the head in all forms except for two members of the subgenus *Blennicottus*. In these latter fishes more accurate and consistent measurements can be secured by measuring the length of the head and snout, and the position of all fin origins, from the upper lip instead of from the poorly defined anterior point of the globular head. These measurements are, therefore, defined as being taken from the lip in all cases. The length of the snout was measured from the most distant point on the median line of the upper lip to the anterior margin of the orbit; the length of the maxillary, from the same point to the most posterior part of the maxillary. The diameter of the orbit was taken as its longest diameter, but care was taken not to include the marked anterior notch between the prefrontal and first suborbital. Measurements involving the positions of the fins were taken from the most distant point on the median line of the upper lip to the base of the first ray or spine (the upper ray in the case of the pectoral, and the spine in the case of the pelvic), the ray being elevated at a sharp angle to the body as the measurement was taken. The length or width of any fin was measured to include the bases of the first and last rays, but omitted any membrane posterior to the last ray. The height of the median fins was measured as the length of the longest ray or spine from its base, as located by touch, to its tip, omitting any terminal cirri or membranous flaps. The longest pectoral ray was measured in the same way, while the pelvic fin was measured from the base of the spine to the tip of the longest ray. The width at the pectoral base was taken as the distance between the bases of the upper pectoral rays. The distances between the first dorsal and pelvic, and between the second dorsal and anal, were measured between the bases of the first rays of the respective fins. The depth of the caudal peduncle was taken as its least vertical depth.

In the count of the fin rays, the last ray was counted as $1\frac{1}{2}$ if it was split

to the base. Possible subdermal bifurcations of the last ray were not considered, and even if the last ray was close to, but not visibly joined to the penultimate ray, it was counted as distinct. Only the branched rays of the caudal were counted. The lateral-line count was of scales in all those species in which they were externally visible; in those forms with reduced and deeply embedded scales, pores were counted. The count was made from the first scale to the end of the hypural, care being taken to avoid counting the posttemporal and supracleithrum, which often appear like somewhat enlarged, anterior, lateral-line scales. Additional scales or pores on the base of the caudal fin are appended to the main count by a + sign.

During the course of this work a number of people rendered valuable help which it is a pleasure to acknowledge. I am particularly indebted to Dr. Tage Skogsberg of the Hopkins Marine Station for encouragement and advice. To Dr. George S. Myers and Miss Margaret Storey of Stanford University; Dr. Carl L. Hubbs of the University of Michigan; Dr. Francis M. Baldwin of the University of Southern California; Mr. P. S. Barnhart of the Scripps Institution of Oceanography; Dr. Elmer Noble of Santa Barbara State College; and Mr. William I. Follett of Oakland, I am indebted for the loan of valuable material. It has been possible for me to make several collecting trips on commercial fishing vessels through the courtesy of Mr. Tony G. Ferranti, the late Mr. Vito Bruno, Spengler Brothers, and A. Paladini & Co., while the California Division of Fish and Game has permitted me to conduct trawling activities from their research vessels on several occasions. A grant of $100 by the Committee on Research of Stanford University made possible the employment of an assistant to aid in the tabulation and calculation of proportions of the more than 35,000 measurements and counts taken.

A number of the drawings were made by Mr. Walter B. Schwarz of Berkeley; the balance are by the author.

Family COTTIDAE

COTTOIDEAE Richardson, 1836, p. 321.
COTTIDAE Swainson, 1839, pp. 181, 270; Lay and Bennett, 1839, p. 57.
COTTOIDEI Bleeker, 1859, p. xxiv.
COTTOIDAE Gill, 1863b, p. 279.
COTTI Fitzinger, 1873, p. 36.
JORDANIIDAE Jordan, Evermann, and Clark, 1930, p. 375.
ICELIDAE Jordan, Evermann, and Clark, 1930, p. 375.
BLEPSIIDAE Jordan, Evermann, and Clark, 1930, p. 382.
SCORPAENICHTHYIDAE Jordan, Evermann, and Clark, 1930, p. 382.

Suborbital stay present (this easily felt by running a needle point downward across the cheek midway between the eye and preopercular margin). Teeth in villiform or cardiform bands on jaws, rarely enlarged to approximate small canines. Gill membranes never free, always united to each other or joined to isthmus; gill openings always continued ventrally below the level of the lower pectoral rays. Body never completely encased in a heavy bony armor. Lateral line present, single, simple, unbranched. First dorsal fin with fewer than 20 spines; no spines in anal; pectorals procurrent and entire, without lower rays detached and modified as tactile organs; pelvics, if present, with one spine and two to five rays, the spine usually so closely bound to first ray by membrane that it can be distinguished only after dissection, the fin not modified into a sucking disk.

ARTIFICIAL KEY TO THE GENERA

1a. Pelvic fins present.

2a. Pelvics I,4 or I,5 (the spine often so closely applied to first ray that it is indistinguishable without dissection).

3a. Strongly ctenoid scales, in four to eight longitudinal rows, forming a wide squamous band immediately below base of dorsal fins; this band bordered ventrally by a broad, smooth, naked area which extends to or almost to the lateral line.....(p. 13) HEMILEPIDOTUS.

3b. Scales, if present, not as above.

4a. Gill membranes free from isthmus; pelvics I,5.

5a. Body without any visible scales; anal rays $11\frac{1}{2}$ to $13\frac{1}{2}$; a large, broad-based, flap-like cirrus extending longitudinally along median line of snout.....(p. 5) SCORPAENICHTHYS.

5b. Scales conspicuous; anal rays $22\frac{1}{2}$ to $24\frac{1}{2}$; no cirrus on median line of snout.

6a. First dorsal XVII or XVIII; dorsal part of body covered by small spine-like scales arranged in crescentic groups and appearing like large, strongly ctenoid scales; ventral part of body with oblique spinous folds; no enlarged spinous plates extending along base of dorsal fins.....(p. 8) JORDANIA.

6b. First dorsal XII or XIII; most of body hispid with irregularly arranged, minute, spinous scales; a series of enlarged scales extending just below base of dorsal fins, each scale bearing a very strong curved spine.....(p. 11) PARICELINUS.

4b. Gill membranes joined to isthmus; pelvics I,4.

7a. Upper preopercular spine antler like (long, with recurved barbs along its upper margin); body naked.....(p. 96) LEPTOCOTTUS.

7b. All preopercular spines small, simple, inconspicuous; body often with some minute prickly scales.....COTTUS, (a fresh-water genus not treated in this review, but with members occasionally straying into salt water near the mouths of rivers.

2b. Pelvics I,2 or I,3 (spine often difficult to distinguish).

8a. Second dorsal 21 to 29; anal 18 to 25.

9a. Anal 18 to 21; body markedly compressed, deep, the distance from second dorsal to anal .229 to .314 of standard length; minute spinous scales embedded in small dermal papillae covering most of body.

10a. Gill membranes joined to isthmus; pelvic fins extending about to anal origin; sides of body, with exception of axilla, completely scaled.....(p. 102) NAUTICHTHYS.

10b. Gill membranes free from isthmus; pelvic fins extending less than half way to anal origin; a series of naked patches on the body, the largest one involving a broad streak along posterior half of lateral line and all of caudal peduncle (p. 99) BLEPSIAS.

9b. Anal 22 to 25; body subcircular in cross section, long and attenuated, the distance from second dorsal to anal .085 to .110 of standard length; scales of body well developed, restricted to the lateral line and a row above it.....(p. 37) RADULINUS.

8b. Second dorsal 9 to 20; anal 7 to 18.

11a. Gill membranes completely joined to isthmus; lateral-line scales developed into a series of very heavy bony plates....(p. 90) ENOPHRYS.

11b. Gill membranes free from isthmus, or at least forming a broad fold across it; scales not developed as heavy bony plates.
12a. First dorsal VI or VII; second dorsal 10 to 13; pectoral 19 to 21; fewer than 20 pores in lateral line.....(p. 94) ZESTICELUS.
12b. First dorsal VII to XI; second dorsal 13 to 20; pectoral 13 to 19; more than 30 pores or scales in lateral line.
13a. Area between dorsal fins and lateral line with well-developed scales in oblique or longitudinal bands, or covering entire area.
14a. Dorsal scale band only two scales wide, extending along back a little below dorsal fins and well above lateral line; pelvics I,2.....(p. 22) ICELINUS.
14b. Dorsal scale band wider, sometimes extending to lateral line; pelvics I,3.
15a. Upper preopercular spine antler like (long with recurved barbs along its upper margin); first dorsal spine produced, much longer than second; first dorsal fin deeply notched between third and fourth spines.....(p. 19) CHITONOTUS.
15b. Upper preopercular spine simple to multifid, but not elongate and antler like; first dorsal spine not produced; first dorsal fin without a pronounced notch.
16a. Anus much nearer pelvic base than anal origin..(p. 59) ORTHONOPIAS.
16b. Anus not notably advanced in position.....(p. 41) ARTEDIUS.
13b. Area between dorsal fins and lateral line entirely naked or with minute prickly scales.
17a. Anus immediately in advance of anal origin.....(p. 61) OLIGOCOTTUS.
17b. Anus located in middle third of distance between pelvic base and anal origin.
18a. Anterior end of first dorsal not elevated, first spine about equal to or shorter than third spine; a large postorbital cirrus, and one or more cirri on opercular flap (p. 72) CLINOCOTTUS.
18b. Anterior end of first dorsal strongly elevated, first spine about twice as long as third spine; no postorbital cirrus and none on base of opercular flap.....(p. 86) LEIOCOTTUS.
1b. Pelvic fins entirely lacking.....(p. 88) ASCELICHTHYS.

Genus SCORPAENICHTHYS Girard

SCORPAENICHTHYS Girard, 1854a, p. 131 (genotype by monotypy *Scorpaenichthys marmoratus* Girard).

Teeth in broad bands on vomer and palatines. No spines on top of head in fronto-parietal region, but this area becoming strongly rugose in old specimens. Preopercular spines simple. Gill membranes broadly united, free from the isthmus. Gills 4; filaments of posterior hemibranch developed along entire arch, although of full length only ventrally; a well-developed slit behind last gill, its length about equal to diameter of pupil.

Body naked, the scales of the lateral line completely embedded and invisible. Anus not advanced in position.

Pelvics I,5 (very rarely I,4 on one side). Some branched rays in all fins except first dorsal.

This genus contains a single species.

SCORPAENICHTHYS MARMORATUS Girard

(Fig. 1)

SCORPAENICHTHYS MARMORATUS Girard, 1854a, p. 131 (San Francisco, California); 1854b, p. 145; 1857a, p. 535; 1858b, p. 64, pl. 16, fig. 1 (plate actually in Suckley, 1860); Jordan and Gilbert, 1881d, p. 454; Eigenmann and Eigenmann, 1892, p. 356; Jordan and Evermann, 1898a, p. 1889; Starks, 1911, p. 191; Metz, 1912, p. 36; Fowler, 1923a, pp. 291, 299; 1923b, p. 79; Walford, 1931, p. 127, fig. 102; Phillips, 1935, p. 148; Schultz and DeLacy, 1936b, p. 128.
HEMITRIPTERAS MARMORATUS Ayres, 1854a, p. 4 (San Francisco, California).
HEMITRIPTERUS MARMORATUS Ayres, 1854a, p. 4 (spelling of generic name corrected in second edition, published in 1873).
SCORPOENICHTHYS MARMORATUS R. Smith, 1880, p. 1; G. H. Clark, 1935, p. 32.

Body heavy and robust anteriorly, markedly compressed posteriorly; width at pectoral base 1.3 (1.1-1.5) in distance from dorsal origin to pelvic base. Caudal peduncle moderately heavy, its depth 1.3 (0.9-1.7) times diameter of orbit.

Head rather large and heavy, its length 2.7 (2.5-2.8) in standard length. Mouth large; maxillary extending to a vertical somewhere between posterior margin of pupil and hind edge of orbit, its length 2.3 (2.0-2.5) in head; lower jaw somewhat shorter than upper, slightly included. Snout moderately steep and long, its length 1.5 (1.0-1.9) times diameter of orbit. Nasal spines heavy, bluntly pointed, semirecumbent and in line with profile of snout. Dermal tube of anterior nostril short, with slightly flaring rim, its posterior margin produced; posterior nostril behind nasal spine, at tip of a low volcano-shaped projection. Eye rather small, orbit 5.1 (3.8-6.4) in head, its length markedly greater than its height; upper orbital margin somewhat elevated and protruding above general profile of head. Interorbital space rather broad, its width a little less than height of orbit; channeled by a broad longitudinal groove. Two short, heavy, preopercular spines, the upper one the larger; preopercular border below these spines produced into a low angular projection in small specimens, becoming evenly rounded in large individuals. Opercular flap bluntly rounded, extending about an orbital diameter behind upper end of gill opening.

Lateral line descending in a gentle curve from upper border of supracleithrum to approach body axis at about vertical of tip of pectoral fin, slightly depressed as it extends onto base of caudal. A large flap-like cirrus on median line of snout, its postero-dorsal border fringed; one or two small cirri on mesial edge of nasal spine, the distal one often double. A pair of long, slender, simple cirri arising from snout between and slightly posterior to nasal spines; one member of this pair often missing. A broad flat cirrus on end of maxillary. A large flattened and fimbriated cirrus with a constricted base occurs at upper posterior margin of orbit. Usually a very small simple cirrus about a pupil length antero-laterad to base of first dorsal spine. Usually a small cirrus-like expansion of the fin membrane at tip of each dorsal spine.

Origin of first dorsal about over end of upper preopercular spine; base of fin 1.3 (1.1-1.5) in base of second dorsal; fin with a sharp anterior angle, evenly rounded posteriorly; fourth (rarely third or fifth) spine somewhat shorter than succeeding spines, producing a slight notch in profile of fin; one or more of the first three spines subequal in length to fifth, sixth, or seventh, and these longest spines 2.0 (1.6-2.5) in base of fin; terminal membrane attached to basal part of first dorsal ray. Origin of second dorsal somewhat in advance of anus, on a vertical midway between caudal base and a point somewhere between anterior rim of

orbit and posterior margin of pupil; fin rounded anteriorly, truncate posteriorly, with a rather sharp angle at tip of antepenultimate ray. Major portion of the distal margin almost straight and somewhat higher anteriorly than posteriorly. The longest ray, somewhere between third and ninth, equal to or somewhat longer than the longest dorsal spine and 2.3 (1.7-2.6) in base of fin. All rays, except the first two, somewhat branched; last ray split to base and counted as $1\frac{1}{2}$. Terminal membrane attached to peduncle under basal 0.8 or 0.9 of depressed last ray. Origin of anal under third to sixth dorsal ray; its last ray under or slightly posterior to base of last dorsal ray; base of fin 1.4 (1.2-1.5) in base of second dorsal; fin similar in shape to second dorsal but somewhat more evenly rounded anteriorly and with all membranes, except on truncated posterior portion, deeply incised; the longest ray, somewhere between sixth and eleventh, is equal to or somewhat shorter than longest dorsal ray and 2.0 (1.6-2.3) in base of fin; all rays branched, the branching of anterior ones usually obscured by thickened membrane except in small specimens; last ray split to base and counted as $1\frac{1}{2}$, free from peduncle except at extreme base. Base of upper pectoral ray under third or fourth dorsal spine; fin extending to vertical of second, third, or fourth dorsal ray, bluntly rounded; sixth or seventh ray longest. Base of fin broad, 2.0 (1.6-2.3) in longest ray. Lower membranes rather deeply incised. Two to four of the upper rays, but not the first, show some terminal branching. Pelvic base on a vertical midway between snout and a point somewhere between fifth and eighth anal ray; fin extending to somewhere between vertical of first and fourth dorsal ray, its length 1.3 (1.1-1.5) times width of pectoral base; second ray longest, fifth ray shortest. The three middle rays, and sometimes the inner one, branched. Fin adnate to belly by membrane involving basal 0.2 or 0.3 of fifth ray. Caudal slightly rounded, its length 1.2 (1.0-1.4) in length of anal base.

Measurements in per mille of standard length, based on 50 specimens 85.6 to 421.0 mm. (average 215.7 mm.) in standard length: distance from first dorsal to pelvic 300 (260-346); distance from second dorsal to anal 258 (228-276); depth of caudal peduncle 93 (85-105); width at pectoral base 237 (210-279); length of head 375 (354-398); length of maxillary 167 (147-185); length of snout 109 (92-120); diameter of orbit 74 (58-98); distance from snout to first dorsal 300 (279-324); length of first dorsal 272 (232-326); height of first dorsal 136 (118-160); distance from snout to second dorsal 564 (527-603); length of second dorsal 360 (318-380); height of second dorsal 156 (138-196); distance from snout to anal 621 (602-665); length of anal 260 (240-285); height of anal 134 (118-167); distance from snout to pectoral 349 (333-375); width of pectoral base 145 (130-167); length of longest pectoral ray 287 (253-317); distance from snout to pelvic 385 (345-464); length of pelvic 191 (173-217); length of caudal 223 (193-254).

Fin and scale formulae: D. XI(X-XII),$17\frac{1}{2}$($15\frac{1}{2}$-$18\frac{1}{2}$); A. $12\frac{1}{2}$($11\frac{1}{2}$-$13\frac{1}{2}$); P. 15 (14-16); V. I,5(4-5); C. 9; Ll. 80(71-88)+6(4-8).

Color very variable. Dark brown, reddish, or green above, fading into translucent white or greenish on belly. Sometimes the color is almost uniform, but more often specimens are strongly and irregularly marbled with light and dark, the more deeply colored patches tending to form five broad cross bars. All fins mottled and barred. Chin and lips blotched with white.

Since juvenile individuals differ strikingly in appearance from adults, the following notes, based on ten specimens 35.1 to 70.5 mm. (average 55.1 mm.) in standard length, are presented. Body markedly compressed, even anteriorly; width at pectoral base 1.5 (1.3-1.9) in distance from dorsal origin to pelvic base. Depth of caudal peduncle about equal to or less than diameter of eye, 0.9 (0.7-1.1) in orbit. Mouth proportionally smaller than in large individuals; the maxillary ex-

tending about to posterior margin of pupil, its length 2.4 (2.3-2.5) in head. In very small specimens the snout is much steeper than in larger ones and, due to the proportionally larger orbit which is 3.7 (3.3-4.2) in head, the snout is about equal to the diameter of the eye, being 0.9 (0.7-1.1) in orbit. Interorbital space somewhat broader than in adults, its width about equal to the lesser diameter of the orbit, almost flat, with the median groove very poorly developed. In very small specimens there are three well-developed, sharply pointed, preopercular spines. All of these become heavier and blunter with increasing age, and in fish 100 mm. in standard length the lower one is nothing more than a low angular projection, hardly to be designated as a spine. Opercular flap shorter than in adults, extending only about 0.5 of an orbital diameter behind upper end of gill opening in small specimens. In very small specimens there is no indication of branching rays, except for the last ray of dorsal and anal each of which is always split.

I have examined specimens of this species from the San Juan Islands, Washington; from Yaquina Head, and from between Arago Light and Sunset Cove, Oregon; and from the following California localities: Crescent City, Lat. 41° 44' 57" N., Long. 124° 12' 28" W.: two miles south of Trinidad, Lat. 41° 01' 45" N., Long. 124° 07' 00" W.; Coast Guard pier, Humboldt Bay, Lat. 40° 46' 02" N., Long. 124° 12' 58" W.; the reef between Iverson Landing and Arena Cove, Lat. 38° 52' 28" N., Long. 123° 39' 47" W.; at Duncan's Landing; two miles north of Bodega Head, Lat. 38° 20' 45" N., Long. 123° 04' 00" W.; Bodega Head, Lat. 38° 18' 23" N., Long. 123° 03' 52" W.; Tomales Point, Lat. 38° 14' 16" N.; Long. 122° 59' 20" W.; Duxbury Reef, Lat. 37° 53' 20" N., Long. 122° 41' 57" W.; Bolinas Bay, Lat. 37° 54' 02" N., Long. 122° 41' 20" W.; Point Bonita; southwest side of Red Rock, San Francisco Bay; San Francisco; south of Rockaway Beach; Moss Beach; Martins Beach; Monterey Bay, Lat. 36° 55' 45" N., Long. 121° 54' 15" W.; mouth of Elkhorn Slough; Monterey harbor; Monterey Bay, Lat. 36° 37' 00" N., Long. 121° 53' 45" W.; Mussel Point, Lat. 36° 37' 20" N., Long. 121° 54' 15" W.; off Pacific Grove; Aumentos Rock, Lat. 36° 38' 03" N., Long. 121° 55' 10" W.; Pescadero Point, Lat. 36° 33' 42" N., Long. 121° 57' 15" W.; Point Vicenti; San Pedro; Scripps Institution pier; banks off Scripps Institution; La Jolla; Point Loma. The recorded range of the species is from the San Juan Islands, Washington, to San Diego, California. It is common in shallow water and specimens often occur in tide pools. It is of slight commercial importance.

Genus JORDANIA Starks

JORDANIA Starks, 1896a, p. 410 (genotype by monotypy *Jordania zonope* Starks).

A few teeth on vomer and palatines. Gill membranes broadly united, free from isthmus. Gills $3\frac{1}{2}$; a well-developed slit behind the last one, its length equal to or somewhat greater than diameter of pupil.

Each of the general body scales in the form of a strong spine arising from a small, deeply embedded, stellate plate. Above the lateral line these scales are arranged in crescentic groups which simulate perfectly the free margins of large, strongly ctenoid scales; below the lateral line they form long, oblique, serrated folds. The lateral-line scales have their ctenoid borders continued postero-ventrally, without interruption, by the oblique series of general body scales. Anus not advanced in position.

First dorsal fin slightly longer than second dorsal; anal markedly longer than second dorsal. Pelvics I,5 (very rarely I,4 on one side).

This genus contains a single species.

JORDANIA ZONOPE Starks

(Fig. 2)

JORDANIA ZONOPE Starks, 1896a, p. 410 (Point Orchard, Washington); Jordan and Evermann, 1898a, p. 1884; 1900, fig. 684; Bean and Weed, 1920, p. 71; Schultz and DeLacy, 1936a, p. 77; Bolin, 1937, p. 63.

Body slender, slightly compressed throughout, particularly posteriorly; width at pectoral base 1.2 (1.1-1.3) in distance from dorsal origin to pelvic base. Caudal peduncle slender, its depth 1.4 (1.2-1.5) in diameter of orbit.

Head small, 3.6 (3.5-3.8) in standard length. Mouth small; maxillary reaching a vertical somewhere between anterior rim of orbit and anterior margin of pupil, its length 3.2 (3.0-3.4) in head. The lower jaw somewhat shorter than upper, slightly included. Snout moderately steep and long, 1.0 (0.8-1.3) in orbit. Nasal spines well developed, sharply pointed, usually in line with profile of snout but often more erect. Anterior nostril in a short tube with its posterior margin expanded into a large flap; posterior nostril with a slightly elevated rim. The eye moderate in size, 3.4 (3.1-3.7) in the head, its length slightly greater than its height. Upper orbital margin somewhat elevated, protruding slightly above general profile of head. Interorbital space rather narrow, its width equal to or slightly greater than diameter of pupil, channeled by a well-defined groove which increases in depth with advancing age. Occipital region flat or slightly concave, without any well-developed spines. Two simple preopercular spines; the upper one minute and straight; the lower one strong, curved upward, sharply pointed. Opercular flap ending in a rounded point, extending about 0.4 of an orbital diameter behind upper end of gill opening. A small and scarcely evident spine just behind end of opercular flap on upper posterior angle of cleithrum.

Lateral line almost straight, descending in a very gentle curve from upper edge of supracleithrum to approach axis at vertical of anal origin. Irregularly arranged scales covering head above level of suborbital stay and longest preopercular spine. The scales extend forward in the groove of interorbital space to or slightly beyond posterior margin of pupil, and on orbital rim to slightly in front of preorbital cirrus; a few scales on outer basal portion of postorbital cirrus. The entire body above lateral line, except for a narrow strip along base of first dorsal fin, covered by imbricated scale-crescents; scales of ventral serrated folds extending obliquely downward and backward in long series, but leaving the axilla, breast, belly, and a narrow ventral streak along base of anal fin and on caudal peduncle naked. Very small spinous scales on rays of first dorsal, second dorsal, and caudal fins, and on upper rays of pectoral. One or two minute, barely visible cirri on preorbital margin directly in front of nasal spine, and usually a similar one on the margin directly laterad to nasal spine. A very small cirrus near end of maxillary. A long slender cirrus on lateral face of nasal spine, and a smaller one on its inner posterior margin. A simple or terminally branched preorbital cirrus on upper anterior orbital margin; this cirrus usually as long as diameter of pupil, rarely poorly developed. A markedly larger postorbital cirrus on upper posterior orbital margin, and three similar but smaller cirri in line behind it, forming a series along the almost undeveloped fronto-parietal ridge. A well-developed single or double cirrus on suborbital stay, and often one or two minute cirri on pore margins along lower part of preopercular border. Spines of dorsal fin with small cirrus-like projections of membrane. No cirri on body.

Origin of first dorsal directly over, or very slightly behind, upper end of gill opening. First two or three spines abruptly shorter than succeeding ones, so

that the anterior part of the fin profile rises sharply in a concave slope; main portion of fin following a gentle and even convex curve, merging into the bluntly rounded posterior profile without any marked angle. The longest spine, somewhere between fourth and twelfth, 2.4 (2.1-2.8) in base of fin. Second dorsal separated from first dorsal by a narrow interspace which is equal to or smaller than the diameter of pupil; its origin over eighth or ninth anal ray, its last ray over last or next to last anal ray; base of fin about 1.1 in base of first dorsal, and 1.5 (1.4-1.5) in base of anal. Fin gently rounded, usually with poorly defined anterior and posterior angles, somewhat higher anteriorly than posteriorly. Longest ray, somewhere between second and sixth, about equal to or somewhat longer than longest dorsal spine and 2.1 (2.0-2.2) in base of fin. In large individuals most of the rays are branched; last ray split to base and counted as $1\frac{1}{2}$; terminal membrane attached to caudal peduncle under basal 0.2 or 0.3 of depressed last ray. Origin of the anal under eleventh to thirteenth dorsal spine. Fin with a marked anterior angle, truncate posteriorly and with a sharp angle at tip of penultimate or antepenultimate ray; distal margin almost straight and parallel to ventral margin of the body. Rays at posterior angle longest, somewhat shorter than longest dorsal rays and 3.7 (3.3-4.3) in base of fin. Next to last ray (but none of the preceding rays) usually branched; the last ray split to base and counted as $1\frac{1}{2}$, attached to peduncle by membrane at extreme base only. Base of upper pectoral ray about under origin of first dorsal; fin extending to a vertical somewhere between fourth and seventh anal ray, sharply pointed; eighth ray longest. Base of fin rather narrow, 3.4 (3.0-3.6) in longest ray. Third to seventh rays, and sometimes even the first two in large specimens, strongly branched; lower rays simple, with deeply incised membranes. Pelvic base midway between snout and a point somewhere between eighth and tenth anal ray; fin sharply pointed; extending to first, second, or third anal ray; its length 2.0 (1.9-2.1) times width of pectoral base. Second ray longest; fifth ray shortest, not adnate to belly. A variable number of the rays branched; the first one is never branched, and rarely all of the rays may be simple. Caudal slightly rounded, rather small, its length 2.4 (2.3-2.5) in anal base.

Measurements in per mille of standard length, based on seven specimens 49.2 to 90.8 mm. (average 73.0 mm.) in standard length: distance from first dorsal to pelvic 187 (175-206); distance from second dorsal to anal 190 (181-196); depth of caudal peduncle 58 (56-60); width at pectoral base 153 (138-173); length of head 272 (260-285); length of maxillary 85 (83-89); length of snout 79 (69-92); diameter of orbit 81 (70-87); distance from snout to first dorsal 252 (239-274); length of first dorsal 317 (305-335); height of first dorsal 133 (111-149); distance from snout to second dorsal 596 (583-606); length of second dorsal 288 (272-300); height of second dorsal 138 (130-146); distance from snout to anal 461 (448-474); length of anal 428 (407-441); height of anal 118 (99-130); distance from snout to pectoral 261 (246-276); width of pectoral base 92 (85-97); length of longest pectoral ray 312 (281-340); distance from snout to pelvic 309 (295-329); length of pelvic 183 (169-193); length of caudal 171 (157-177).

Fin and scale formulae: D. XVIII(XVII-XVIII)—$16\frac{1}{2}$($16\frac{1}{2}$-$17\frac{1}{2}$); A. $23\frac{1}{2}$($22\frac{1}{2}$-$24\frac{1}{2}$); P. 14; V. I,5(4-5); C. 10(8-10); Ll. 50(48-50)+2(2-3).

Dorsal part of body marbled with slate gray and orange red, becoming grayish orange ventrally; back crossed by about seven cross bars, darker in tone but marbled with the same colors; an additional dark streak at base of caudal. Dorsal part of head red, crossed by narrow slate-colored bars; below the eye the color changes to chocolate brown; chin and gill membranes blackish. Spines of the first dorsal barred with red and gray, the membranes black; second dorsal dark brown or reddish; anal speckled with red and black; caudal bright orange; upper part of pectoral dark brown, lower part black; pelvics black.

I have examined specimens of this species from the following localities: Point Orchard, Washington (three syntypes); San Juan Island, Washington; off Point Joe, California, Lat. 36° 38' 00" N., Long. 121° 57' 30" W.; Point Lobos, California, Lat. 36° 31' 07" N., Long. 121° 57' 14" W. Its known range is from Ucluelet, British Columbia, to Point Lobos, California, and from the intertidal region to a depth of 21 fathoms. It is nowhere common and it has been taken only twice in California.

Genus PARICELINUS Eigenmann and Eigenmann

PARICELINUS Eigenmann and Eigenmann, 1889b, p. 131 (genotype by original designation *Paricelinus hopliticus* Eigenmann and Eigenmann).
ALCIDEA Jordan and Evermann, 1898a, p. 1886 (genotype by original designation *Paricelinus thoburni* Gilbert = *P. hopliticus* Eigenmann and Eigenmann).

Teeth in broad bands on vomer and palatines. Head with strong serrations and spines around orbits, on occiput, and on suborbital stay. Gill membranes broadly united, free from the isthmus. Gills 3½; a small slit behind the last one, its length equal to about 0.5 diameter of pupil.

Body almost completely scaled; the general body scales small, each bearing a single, prominent, slightly curved spine; lateral-line scales enlarged and with somewhat larger spines. A series of 34 or 35 very much enlarged scales extending along base of dorsal fins; these prominent plates bearing hooked spines similar in size and shape to those of fronto-parietal ridge. Anus not advanced in position.

Anal fin markedly longer than second dorsal. Pelvics I,5. Some branched rays in all the fins except the first dorsal.

This genus contains a single species.

PARICELINUS HOPLITICUS Eigenmann and Eigenmann

(Fig. 3)

PARICELINUS HOPLITICUS Eigenmann and Eigenmann, 1889b, p. 131 (Cortez Banks); Jordan and Evermann, 1898a, p. 1886; Bolin, 1937, p. 63.
PARICELINUS THOBURNI Gilbert, 1895, p. 432, pl. 30 (Albatross station 3350, off Point Arena, California, not off coast of Oregon as stated in type description).
ALCIDEA THOBURNI Jordan and Evermann, 1898a, p. 1887; 1900, fig. 685.
"PARISCELINUS THABURNI" Schultz and DeLacy, 1936a, p. 78 (corrected to "*Paricelinus thoburni*" in reprint).

Body attenuate; subcircular in cross section throughout, only very slightly compressed posteriorly; width at pectoral base 1.3 in distance from dorsal origin to pelvic base. Caudal peduncle rather slender, its depth about 1.4 in diameter of orbit.

Head small, its length about 3.9 in standard length. Mouth small; maxillary not quite reaching a vertical from anterior margin of pupil, its length 2.8 in head. Jaws about equal in length, the lower one not included. Snout not steep, rather long, its length about 1.2 times diameter of orbit. Nasal spines well developed, sharply pointed, about in line with profile of snout. Both nostrils in short tubes of about equal size and with constricted rims; posterior rim of anterior nostril slightly expanded. Eye large; orbit about 3.5 in head, its length somewhat

greater than its height. Upper orbital margin elevated, protruding above general profile of head, its posterior half armed with strong spine-like serrations. Interorbital space narrow, its least width slightly less than diameter of pupil, channeled by a deep U-shaped groove. Occipital region somewhat depressed between the low, rounded, fronto-parietal ridges which bear two strong semirecumbent spines, forming a linear series with a similar but slightly larger postocular spine; two similar but smaller spines somewhat laterad to those on fronto-parietal ridge, forming a linear series with a strong spine on posttemporal and the serrated free edge of the supracleithrum. Suborbital margin marked by strong irregular serrations continuous with the even stronger ones on suborbital stay, the entire series subdivided into three fairly well-separated groups of spines. The three posterior circumorbitals each with one or two small spines, scarcely larger than those of adjacent scales. Three simple preopercular spines (lowest spine narrowly bifid on one side of the specimen at hand), the middle one largest. A strong spine just behind end of opercular flap on upper posterior angle of cleithrum. Opercular flap ending in a rounded point, extending about 0.5 of an orbital diameter behind upper end of gill opening.

Lateral line almost straight, about equidistant from dorsal body margin at all points and approaching axis of body only on caudal peduncle. A few small scales in a single series along upper anterior orbital margin; scattered scales on anterior third of interorbital space. A patch of widely scattered scales extends from immediately behind upper posterior angle of maxillary to end of serrated crest of suborbital stay, and there merges with the dense squamation which covers the head above the level of the longest preopercular spine and behind the vertical of the postorbital cirrus. Body squamation continuous with that of the head, and complete except for a narrow streak along base of anal fin and an area under pectoral and pelvic fins. A narrow band of widely spaced scales extends downward in the axilla and joins a large patch of scales on the breast which sends a narrow streak of scales backward between the ventrals to separate the naked areas of the two sides. Some of the scales at the base of the caudal are enlarged. Minute spinous scales on rays of dorsal and caudal fins, and on upper rays of pectorals. No cirri on nasal spines. A single small cirrus on lower margin of suborbital, directly below base of nasal spine. A very small cirrus on end of maxillary, and a pair of well developed flattened cirri on cheek just behind end of maxillary. A large flattened postorbital cirrus with fringed tip. Two or three small cirri on preopercular margin and one on posterior end of suborbital stay. Usually a small cirrus on base of opercular flap. No cirri behind the head.

Origin of first dorsal slightly behind upper end of gill opening but in front of tip of opercular flap. Base of fin 1.8 in base of second dorsal. Fin with a marked anterior angle, and evenly rounded posteriorly, its distal margin almost straight and parallel to base. The longest spine, somewhere between second and sixth, is about 2.3 in base of fin. Second dorsal contiguous to first dorsal; its origin about over fourth anal ray, its last ray about over antepenultimate anal ray; base of fin about 1.2 in base of anal. Fin similar in shape to first dorsal but markedly longer. Longest dorsal ray, somewhere between fifth and fourteenth, about 1.3 times as long as longest dorsal spine and 3.3 in base of fin. All rays branched, the last ray split to base and counted as $1\frac{1}{2}$. Terminal membrane attached to caudal peduncle under basal 0.5 of depressed last ray. Origin of anal about under next to last dorsal spine; shape of fin similar to that of second dorsal, but somewhat more evenly rounded anteriorly and with all membranes, except on the truncated posterior portion, deeply incised. Twentieth or twenty-first ray longest, somewhat shorter than longest dorsal ray and 4.7 in base of fin. All rays of anal

branched; the last ray split to base and counted as $1\frac{1}{2}$, entirely free from caudal peduncle. Base of upper pectoral ray under second or third dorsal spine; fin extending to a vertical somewhere between second and fifth anal ray; tenth ray the longest. Base of fin rather narrow, about 2.5 in longest ray. Fin made up of two more or less distinct parts: the upper part of nine rays, bluntly rounded, with all except the first two rays branched and the membranes not incised; lower part with its upper rays a little longer than rays immediately above, more gently and evenly rounded than upper part, the rays all simple and the membranes so deeply incised that about half the length of each ray is entirely free. Pelvic base about midway between tip of snout and eighth anal ray; fin extending to somewhere between anus and second anal ray, its length 1.7 times width of pectoral base. Fin pointed; second ray longest, fifth ray shortest, not adnate to belly; all rays, except the first, branched. Caudal truncate, its length about 2.7 in anal base.

Measurements in per mille of standard length, based on a single specimen 157.7 mm. in standard length: distance from first dorsal to pelvic 183; distance from second dorsal to anal 138; depth of caudal peduncle 53; width at pectoral base 148; length of head 264; length of maxillary 94; length of snout 88; diameter of orbit 75; distance from snout to first dorsal 247; length of first dorsal 212; height of first dorsal 92; distance from snout to second dorsal 494; length of second dorsal 384; height of second dorsal 115; distance from snout to anal 445; length of anal 477; height of anal 101; distance from snout to pectoral 268; width of pectoral base 85; length of longest pectoral ray 213; distance from snout to pelvic 294; length of pelvic 146; length of caudal 179.

Fin and scale formulae: D. XII(XII-XIII), $19\frac{1}{2}$; A. $23\frac{1}{2}$; P. 15; V. I,5; C. 8; Ll. 43+1(1-2).

General ground color greenish brown. Back crossed by about six poorly defined cross bars of darker color; sides below lateral line with seven or eight diffuse purplish blotches. Lateral line flecked with small brownish-yellow spots, and with a line of small pale blue spots below it. Ventral regions gray, except for silvery shades on isthmus and on belly, where the peritoneum shows through the translucent body wall. First dorsal barred with yellowish brown and olive green; second dorsal, caudal, and upper half of pectoral with brown suffusing rays, otherwise transparent; anal pale bluish at base; pelvics tipped with lemon yellow.

I have examined specimens of this species from the following localities: off Florence, Oregon, Lat. 44° 00' 00" N., Long. 124° 57' 00" W.; off Shelter Cove, California, Lat. 39° 53' 00" N., Long. 124° 07' 00" W.; off Point Arena, Lat. 38° 58' 10" N., Long. 123° 57' 05" W. (holotype of *Paricelinus thoburni*); Cortez Banks (holotype). This includes all of the known specimens but, since three of them are in Washington and unavailable to me at present, my description is based mainly on the single specimen from off Shelter Cove. I have, however, drawn upon previous descriptions for variations in meristic characters and such other details as permit no room for doubt. This very rare species is known from depths of between 48 and 100 fathoms.

Genus HEMILEPIDOTUS Cuvier

HEMILEPIDOTUS Cuvier, 1829, p. 165 (genotype by monotypy *Cottus hemilepidotus* Tilesius); Schmidt, 1929a, p. 360; Rendahl, 1931a, p. 36.

TELINISTIA Richardson, 1836, p. 59 (genotype by monotypy *Blepsias ventricosus* Eschscholtz = *Cottus hemilepidotus* Tilesius).

CALYCILEPIDOTUS Ayres, 1855, p. 76 (genotype by subsequent designation of Jordan and Evermann, 1896, *Calycilepidotus spinosus* Ayres).

Body heavy, robust, subcircular in cross section anteriorly, markedly compressed posteriorly. Caudal peduncle moderately heavy.

Head large and heavy, broad and depressed. Lower jaw somewhat shorter than upper, slightly included. Teeth in broad bands on vomer and palatines. Nasal spines strong, sharply pointed, semirecumbent in small specimens, becoming erect in older individuals. Upper orbital margin markedly elevated except in young, protruding above general profile of head; interorbital space rather broad, deeply grooved. Four short, heavy, simple, preopercular spines; upper spine longest, about equal in length to diameter of pupil; lower spine shortest, directed downward and forward, sharply pointed but, when covered by skin, appearing as a bluntly angular expansion of the preopercular border. Opercular flap rather sharply pointed and extending about 0.5 of an orbital diameter below and behind the upper end of gill opening; a short flat spine on its basal portion marking the end of the opercle. Another similar spine on posterior border of cleithrum directly behind opercular flap. A blunt spine on margin of subopercle directly behind second preopercular spine, and another similar one on its postero-ventral corner behind third preopercular spine. Gills four; the filaments of posterior hemibranch of last gill are developed only on ventral part of arch, and are never as long as those of anterior hemibranch; a small slit behind last gill.

Lateral line describing a very flat sigmoid curve, descending from upper border of supracleithrum to approach body axis at about vertical of end of pectoral fin, armed with moderately ctenoid scales. A rather wide band of ctenoid scales extending along base of dorsal fins; the bands of the two sides continuous around front of first dorsal, extending slightly beyond posterior end of second dorsal; upper row of scales markedly reduced in size. A single row of similar scales immediately above middle part of lateral line; these scales sometimes widely and irregularly spaced, and often with one or two supernumerary scales directly above them. A ventral band of similar scales originates just behind cleithral spine and extends to caudal base; this band, narrow anteriorly, widens at vertical of anal origin and behind this point occupies approximately half of the space between lateral line and anal fin. A number of similar but markedly smaller scales behind axille. A series of cirri along suborbital border; the first of these single and in front of nasal spine, followed by a group of three to five short stout cirri at or slightly in front of vertical of anterior orbital margin; another group of one to three similar cirri under posterior part of orbit; final cirrus of this series about under the middle of suborbital stay, flattened and usually enlarged. Often one to three minute cirri forming an ascending series behind this flap, the upper one on suborbital stay. A large flattened cirrus near end of maxillary. A pair of prominent mental cirri arising from bases of recumbent tubes through which the anterior pores of the mandibular latero-sensory canal open. A small cirrus on lower lip about at vertical of anterior margin of orbit. Nasal spines bearing one or two flattened and often fringed cirri. A large flattened and fimbriated cirrus at the upper posterior border of orbit; a similar but smaller one on posterior end of fronto-parietal ridge. A pair of cirri, often enlarged and fringed, between the postorbital cirri and forming a transverse series with the latter. A well-developed cirrus just in advance of upper end of gill opening. Often one to four small cirri on spines and ridges of occipital region, and usually one to four small cirri on lower part of preopercular border. Anterior half of lateral line with two to eight long, slender, often flattened cirri scattered along scale margins. Anus not advanced in position.

Origin of first dorsal well behind tip of upper preopercular spine but in front of upper end of gill opening. Fin with a sharp anterior angle; deeply notched

, third (rarely fourth) spine, which is usually shorter than preceding spine and ways abruptly shorter than succeeding spine; membrane behind this short spine ry deeply incised; postero-distal margin of fin forming an almost straight de- ending line. Second dorsal continuous with first dorsal, the membrane from the ist spine attached to the basal 0.3 to 0.5 of the first ray. Origin of fin midway etween base of caudal and a point somewhere between base of nasal spine and the nterior margin of pupil. Fin gently rounded anteriorly, bluntly rounded or trun- ate posteriorly, its distal margin very gently curved and almost parallel to the ontour of back. A number of the middle rays of second dorsal branched in large ndividuals. Anal similar in shape to second dorsal; all membranes, except on the runcated posterior portion, moderately incised; a slight tendency toward branching n some of the rays behind middle of fin in very large specimens; last ray always plit to base and counted as $1\frac{1}{2}$. Base of upper pectoral ray under second to fourth orsal spine; base of fin broad, strongly procurrent. Fin bluntly rounded; lower embranes moderately incised; none of the rays branched. Pelvic I,4; fin bluntly ounded; second ray longest, fourth ray shortest; none of the rays branched; fin inate to belly by membrane involving basal 0.3 or 0.4 of last ray. Caudal slightly ounded, rather large.

This genus contains about five species, two of which are known from the aters of California.

KEY TO THE CALIFORNIA SPECIES

a. Dorsal scale band of seven or eight rows; gill membranes attached to isthmus at or near their posterior margins, so that if a free fold extends across midline it is much narrower than a pupil diameter; posterior margin of anterior nostril much produced....(p. 15) H. SPINOSUS.

b. Dorsal scale band of four or five rows; gill membranes attached to isthmus somewhat in advance of their posterior margins, so that a free fold, about a pupil diameter in width, extends across midline; posterior margin of anterior nostril not produced.(p. 17) H. HEMILEPIDOTUS.

HEMILEPIDOTUS SPINOSUS (Ayres)

(Fig. 4)

ALYCILEPIDOTUS SPINOSUS Ayres, 1855, p. 76 (San Francisco Bay); Jordan and Evermann, 1898a, p. 1937; Starks and Morris, 1907, p. 219; Hubbs, 1928, p. 14.
EMILEPIDOTUS SPINOSUS Girard, 1856, p. 134; 1858b, p. 68; Jordan and Gilbert, 1881d, p. 454.

Width at pectoral base 1.1 (0.9-1.2) in distance from dorsal origin to the elvic base. Caudal peduncle 1.5 (1.2-1.7) in orbit.

Head 2.6 (2.4-2.7) in standard length. Mouth large; maxillary extending to vertical somewhere between anterior margin of pupil and posterior edge of orbit, ts length 2.2 (2.1-2.5) in head. Snout moderately steep and long, 1.0 (0.8-1.2) n orbit. Dermal tube of anterior nostril with slightly flaring rim, low anteriorly ut with posterior margin much elevated so that it is about twice as high as the nterior margin and extends more than the diameter of the nostril above surface of snout; posterior nostril in volcano-shaped tube with constricted rim; tube about qual in size to anterior nostril without elevated flap. Eye rather large; orbit

3.7 (3.1-4.1) in head, its length markedly greater than its height. Postero-dorsa orbital margin bearing a few, low, bluntly rounded, knob-like elevations. Width o interorbital space about equal to or slightly less than diameter of pupil; it rather deep groove marked by a pair of longitudinal ridges. Except in juvenil specimens the interorbital space is limited posteriorly by a complex of spines an blunt elevations that form the anterior border of the markedly depressed occipita region. Fronto-parietal ridges heavy and prominent; a similar but somewhat les pronounced ridge diverging from anterior end of each fronto-parietal ridge an extending almost to upper end of gill opening; these ridges feebly rugose in large individuals. A pair of strong recumbent spines behind upper posterior border o orbit, the outer one on anterior end of fronto-parietal ridge; these spines become evident in specimens about 90 mm. in standard length and increase in prominence with advancing age. Posterior margins of gill membranes usually attached to isthmus without any free fold across median line; occasionally the attachment is slightly in advance of the united margins, but the resulting fold is always very narrow. Length of slit behind last gill equal to about 0.5 diameter of pupil.

Dorsal scale band of seven or eight rows; the lower row, counted from median line, of 75 to 85 scales; 22 to 37 scales in series immediately above lateral line. Last scale of lateral line bearing one or two cirri; sometimes a cirrus on penultimate scale as well.

Base of first dorsal fin 1.7 (1.6-2.0) in base of second dorsal; longest spine, somewhere between fourth and seventh, 2.1 (1.7-2.4) in base of fin. Longest ray of second dorsal, somewhere between fifth and eleventh, markedly longer than longest dorsal spine and 2.4 (2.1-2.7) in base of fin; branching of middle rays becoming evident in specimens about 90 mm. in standard length; last ray almost always split to base and counted as $1\frac{1}{2}$, very rarely single and counted as 1; terminal membrane attached to peduncle under basal 0.8 or 0.9 of depressed last ray. Anal origin under third to fifth dorsal ray, its last ray under penultimate or antepenultimate dorsal ray; base of fin 1.3 (1.2-1.4) in base of second dorsal; longest ray, somewhere between the seventh and fourteenth, intermediate in length between longest dorsal spine and longest dorsal ray and 2.3 (2.1-2.5) in base of fin; terminal membrane attached to peduncle under basal 0.1 or 0.2 of depressed last ray. Pectoral extending to or almost to vertical of anal origin; sixth or seventh ray longest; base of fin 1.9 (1.7-2.3) in longest ray. Pelvic base midway between snout and a point somewhere between third and sixth anal ray; fin extending to a vertical somewhere between last dorsal spine and third dorsal ray; its length 1.5 (1.3-1.7) times width of pectoral base. Caudal 1.3 (1.1-1.5) in anal base.

Measurements in per mille of standard length, based on 22 specimens 33.5 to 202.5 mm. (average 124.4 mm.) in standard length: distance from first dorsal to pelvic 238 (215-273); distance from second dorsal to anal 204 (185-233); depth of caudal peduncle 73 (63-90); width at pectoral base 225 (209-258); length of head 390 (368-420); length of maxillary 175 (150-191); length of snout 105 (85-121); diameter of orbit 106 (94-128); distance from snout to first dorsal 332 (305-370); length of first dorsal 228 (198-258); height of first dorsal 110 (101-128); distance from snout to second dorsal 546 (534-572); length of second dorsal 393 (370-418); height of second dorsal 165 (150-183); distance from snout to anal 599 (566-627); length of anal 307 (273-347); height of anal 132 (121-149); distance from snout to pectoral 367 (338-407); width of pectoral base 138 (126-161); length of longest pectoral ray 267 (242-305); distance from snout to pelvic 342 (292-394); length of pelvic 198 (176-233); length of caudal 227 (204-279).

Fin and scale formulae: D. XI,$19\frac{1}{2}$($18\frac{1}{2}$-$20\frac{1}{2}$); A. $15\frac{1}{2}$($14\frac{1}{2}$-$16\frac{1}{2}$); P. 15(14-16); V. I,4; C. 9(7-10); Ll. 61(57-66)+4(3-6).

General ground color brown tinged with red. Dark lines radiating from orbit; the first of these passing just behind nasal spines and extending across lips; the second extending straight downward from under anterior part of pupil; the third passing just behind maxillary; the fourth narrow, ill defined, extending to base of upper preopercular spine. Broad, dark, cross bars extending over back, becoming forked, broken, or indistinct at lower edge of ventral scale band; one under the anterior end and one under middle of first dorsal fin; one under anterior part, one under middle, and one under posterior end of second dorsal; last bar at base of caudal. Usually other less distinct patches of dark color between main cross bars. Belly white, without dark spots. All fins barred, except pelvics which are slightly smudged with brown.

I have examined specimens of this species from the following localities, all in California: Point St. George; Crescent City, Lat. 41° 44' 57" N., Long. 124° 12' 28" W.; Point Delgada, Lat. 40° 01' 05" N., Long. 124° 05' 00" W.; south of Bruhel Point, Lat. 39° 36' 17" N., Long. 123° 47' 17" W.; off Bolinas Point, Lat. 37° 50' 40" N., Long. 122° 51' 00" W.; Lat. 37° 50' 30" N., Long. 122° 51' 00" W.; pier at north end of Van Ness Avenue, San Francisco, Lat. 37° 48' 23" N., Long. 122° 25' 34" W.; Monterey; Monterey Bay, Lat. 36° 37' 35" N., Long. 121° 53' 50" W.; Lat. 36° 38' 05" N., Long. 121° 53' 50" W.; Pacific Grove; Point Lobos, Lat. 36° 31' 07" N., Long. 121° 57' 14" W. The known range of the species is from Cape Johnson, Washington, to the Santa Barbara Islands, California. It occurs in water of moderate depth and sometimes straggles into the intertidal region. Not very common in California.

HEMILEPIDOTUS HEMILEPIDOTUS (Tilesius)

(Fig. 5)

COTTUS HEMILEPIDOTUS Tilesius, 1810, p. 262 (Petropavlovsk, Kamchatka).
COTTUS TRACHURUS Pallas, 1811, p. 138 (Kurile Islands).
HEMILEPIDOTUS HEMILEPIDOTUS Jordan and Evermann, 1896, p. 439; 1898a, p. 1935; 1900, fig. 705; Schmidt, 1929a, p. 360; Evermann, 1930, p. 573; Rendahl, 1931a, p. 32; Schultz and Welander, 1934, p. 5; Schultz and DeLacy, 1936b, p. 127.
HEMILEPIDOTUS TILESII Cuvier and Valenciennes, 1829, p. 276, pl. 85 (after Tilesius and Pallas).
BLEPSIAS VENTRICOSUS Eschscholtz, 1829, p. 4, pl. 13 (Norfolk Sound and Sitka).
TEMNISTIA VENTRICOSA Richardson, 1836, p. 59.
HEMILEPIDOTUS GIBBSII Gill, 1863a, p. 13 (San Francisco).
HEMILEPIDOTUS TRACHURUS Jordan and Gilbert, 1882b, p. 715.

Width at pectoral base 1.1 (1.1-1.2) in distance from dorsal origin to the pelvic base. Caudal peduncle 1.2 (1.0-1.4) in orbit.

Head 2.6 (2.5-2.7) in standard length. Mouth large; maxillary extending to a vertical somewhere between anterior margin of pupil and posterior edge of orbit, its length 2.3 (2.1-2.4) in head. Snout steep, moderately long, 0.9 (0.7-1.2) in the orbit. Dermal tube of anterior nostril short, with flaring rim, its posterior border scarcely elevated and not extending more than diameter of nostril above surface of snout; posterior nostril in a short tube about equal in size to that of anterior nostril. Eye rather large; orbit 4.1 (3.1-4.6) in head, its length slightly greater than its height. Width of interorbital space somewhat greater than the diameter of pupil; in specimens over 100 mm. in standard length its deep groove is marked by rows by bony granulations which merge into serrated ridges in large indi-

viduals. Occipital region slightly concave. Fronto-parietal ridges low, rounded; a similar but less prominent ridge extends backward from each orbit to the upper end of gill opening; still another ridge on opercle. In large specimens these ridges, as well as the circumorbital bones and suborbital stay, become strongly rugose; the bony wrinkles granulated with numerous small osseous prominences. Gill membranes attached to isthmus somewhat in advance of their united posterior margins, so that a free fold, about a pupil diameter in width, extends across the median line. Length of slit behind last gill equal to about 0.7 or 0.8 diameter of orbit.

Dorsal scale band of four or five rows; the lower row, counted from median line, of 66 to 76 scales; nine to 26 scales in series immediately above the lateral line. Rarely a few small, deeply embedded scales persist in adults as a single longitudinal series extending above the base of anal fin. First suborbital cirrus flattened laterally, often branched in large specimens; one of the cirri under eye often elevated and occurring well above the suborbital edge; occasionally a small cirrus immediately in advance of the main postorbital one, and sometimes a smaller one in groove of interorbital space. A small but strongly fringed cirrus often occurs a little laterad to the one on the end of the fronto-parietal ridge; sometimes a small cirrus immediately behind tip of upper preopercular spine; in old specimens a pair of small mental cirri occur on pore margins between the main pair. Rarely any cirrus at end of lateral line.

Base of first dorsal fin 1.6 (1.5-1.7) in base of second dorsal; longest spine, somewhere between fourth and sixth, 1.9 (1.6-2.4) in base of fin. Longest ray of second dorsal, somewhere between fourth and eleventh, markedly longer than longest dorsal spine and 2.2 (2.0-2.3) in base of fin; branching of middle rays becoming evident in specimens about 140 mm. in standard length; last ray split to base and counted as $1\frac{1}{2}$; terminal membrane attached to peduncle under basal 0.8 or 0.9 of depressed last ray. Anal origin under second to fourth dorsal ray, its last ray under second to fourth ray from end of second dorsal; base of fin 1.2 (1.2-1.4) in base of second dorsal; longest ray, somewhere between sixth and thirteenth, is intermediate in length between longest dorsal spine and longest dorsal ray and 2.1 (1.9-2.2) in base of fin; terminal membrane attached to peduncle under basal 0.1 or 0.2 of depressed last ray. Pectoral extending to a vertical somewhere between first and fourth anal ray; seventh ray longest; base of fin 1.9 (1.7-2.0) in longest ray. Pelvic base midway between snout and a point somewhere between first and fifth anal ray; fin extending to a vertical somewhere between last dorsal spine and fifth dorsal ray, its length 1.5 (1.4-1.6) times width of pectoral base. Caudal 1.3 (1.2-1.4) in anal base.

Measurements in per mille of standard length, based on seven specimens 63.6 to 215.0 mm. (average 138.7 mm.) in standard length: distance from first dorsal to pelvic 272 (252-294); distance from second dorsal to anal 256 (249-261); depth of caudal peduncle 81 (76-88); width at pectoral base 238 (214-262); length of head 383 (364-398); length of maxillary 170 (160-189); length of snout 108 (97-116); diameter of orbit 95 (86-123); distance from snout to first dorsal 338 (332-349); length of first dorsal 249 (239-267); height of first dorsal 129 (112-155); distance from snout to second dorsal 564 (544-584); length of second dorsal 400 (387-415); height of second dorsal 186 (168-203); distance from snout to anal 594 (577-608); length of anal 321 (305-332); height of anal 152 (138-174); distance from snout to pectoral 368 (347-381); width of pectoral base 163 (152-178); length of longest pectoral ray 301 (280-317); distance from snout to pelvic 326 (311-349); length of pelvic 246 (234-281); length of caudal 254 (239-262).

Fin and scale formulae: D. XI(X-XI),$19\frac{1}{2}$($18\frac{1}{2}$-$20\frac{1}{2}$); A. $15\frac{1}{2}$($13\frac{1}{2}$-$16\frac{1}{2}$); P. 16 (15-16); V. I,4; C. 9(9-10); Ll. 64(59-69)+4(2-5).

Color olivaceous or reddish, mottled with darker spots which are concentrated in certain areas to form radiating lines from orbit and broad cross bars over the back; belly and lower parts pale, usually profusely covered with blackish spots; fins all speckled or barred.

I have examined specimens of this species from Karta Bay, Alaska; from the San Juan Islands and Puget Sound, Washington; and from Mussel Point, California, Lat. 36° 37' 20" N., Long. 121° 54' 15" W. The recorded range of the species is from Peter the Great Bay, Siberia, to the southern end of Monterey Bay, California. In listing Peter the Great Bay as the Asiatic limit of the range, I follow Rendahl, 1931a, but it should be noted that great uncertainty exists as to the exact species of the genus involved in many records south and west of the type locality. This shallow-water species, which sometimes enters tide pools, is common in Alaska but rare in California.

Genus CHITONOTUS Lockington

CHITONOTUS Lockington, 1882, p. 141 (genotype by original designation *Chitonotus megacephalus* Lockington = *Artedius pugetensis* Steindachner).

Teeth in narrow bands on vomer and palatines. Four preopercular spines; the upper one antler like, with a simple or bifid tip and from one to five recurved barbs along its upper margin; lower three spines sharp, usually simple, slightly larger than recurved barbs of antler-like spine, the upper one directed backward, the middle one downward and backward, the lower one downward and forward. Rarely one or more of these normally simple spines may be bifid. Gill membranes broadly united, free from isthmus. Gills $3\frac{1}{2}$, no slit behind the last one.

Strongly ctenoid scales covering most of the dorsal surfaces. On the snout the scales are small and usually widely scattered, while completely naked areas surround the nostrils. The scales form a dense covering in the interorbital space and on the posterior part of the head above the level of the suborbital stay. Numerous small scales occur on the dorsal portions of eyeball, and a narrow streak of scales extends under entire orbit. The scales of the body are somewhat larger than those of the head and densely cover most of the dorsal surface, leaving only a very narrow naked area immediately above the lateral line and another around base of dorsal fins. Lateral line armed with enlarged scales which bear strongly ctenoid ridges along their upper and posterior margins. No scales below lateral line. Anus slightly advanced in position, so that the distance between the pelvic base and anal origin is divided in the proportion of about six to four.

Pelvic fins I,3. No branched rays in any of the fins except the caudal.

This genus is monotypic.

CHITONOTUS PUGETENSIS (Steindachner)

(Fig. 6)

ARTEDIUS PUGETENSIS Steindachner, 1877, p. 133, pl. 14 (Fox Island, Port Townsend, and San Francisco); Jordan and Jouy, 1882, p. 6.
ARTEDIUS PUGETTENSIS Lockington, 1879, p. 26.
CHITONOTUS MEGACEPHALUS Lockington, 1882, p. 142 (San Francisco); Gilbert, 1895, p. 469.
CHITONOTUS PUGETTENSIS Lockington, 1882, p. 144.

ARTEDIUS MEGACEPHALUS Jordan and Gilbert, 1882a, p. 61; Jordan, 1887, p. 612.
ICELUS MEGACEPHALUS Jordan and Gilbert, 1882b, p. 692.
ICELUS PUGETTENSIS Jordan and Gilbert, 1882b, p. 692.
CHITONOTUS PUGETENSIS Jordan, 1885, p. 110; Jordan and Evermann, 1898a, p. 1890; Gilbert, 1899, p. 26; Jordan and Evermann, 1900, fig. 687; Starks and Morris, 1907, p. 218; Gilbert, 1915, p. 338; Bean and Weed, 1920, p. 72; Fowler, 1923a, pp. 282, 291, 299; Ulrey and Greeley, 1928, p. 10; H. W. Clark, 1936, p. 395.

Body robust anteriorly, subcircular in cross section, width at pectoral base 1.1 (0.9-1.2) in distance from dorsal origin to pelvic base. Caudal peduncle rather slender, its depth 2.0 (1.7-2.4) in orbit.

Head large, 2.8 (2.5-3.1) in standard length. Mouth very large; maxillary extending to a vertical somewhere between posterior margin of pupil and posterior rim of orbit, or even slightly beyond this point; length of maxillary 1.9 (1.8-2.0) in head. Lower jaw shorter than upper, strongly included. Snout moderately steep and long, its length 1.2 (1.0-1.4) in the orbit. Nasal spines rather small, sharp, erect, about in line with profile of snout. Anterior nostrils in well-developed tubes, their posterior rims produced into triangular valvular flaps; posterior nostrils in shorter tubes. Eye large; orbit 3.3 (3.0-3.6) in head, markedly longer than high; upper orbital margins not elevated. Interorbital space flat and very narrow, its width less than 0.5 posterior width of maxillary. Top of head marked by a Y-shaped depression, the broad stem of the Y directed posteriorly. Frontoparietal ridges terminating in sharp spines; three (rarely two or four) similar spines behind upper posterior margin of orbit, the most lateral of these about equal in size to nasal spines, the median two progressively smaller and with closely approximated bases, often tending to cross each other. Opercular flap extending about 0.6 of an orbital diameter behind upper end of gill opening, its tip obliquely truncated.

Lateral line forming an abrupt descending arch over opercular flap, then extending in a more gradually arched curve to a point somewhat behind tip of pectoral fin and continued posteriorly as a straight line along body axis. A long, slender, flattened cirrus just mesad to base of nasal spine; a single well-developed cirrus on eyeball; a larger one on upper posterior margin of orbit, this frequently with expanded tip and fringed edges, rarely with a second smaller cirrus near its base. Rarely a single cirrus on posterior part of maxillary, and rarely one on base of opercular flap. No other cirri on head or body. Genital papilla of female small and simple; that of male developed into a complex penis which, when fully developed, is longer than the diameter of orbit; its basal portion cylindrical, the distal portion abruptly narrowed and in the form of a blunt curved cone, from the postero-dorsal surface of which arises a long, slender, recurved flagellum which in adults may extend fully to the base of the organ; in small males about 55 mm. in standard length the flagellum is just beginning to develop and is about as long as the distal part of the curved cone; in such specimens the tip of the penis appears bifid.

Origin of first dorsal about over or somewhat in advance of upper end of gill opening; base of fin 1.4 (1.2-1.6) in base of second dorsal. Fin very deeply notched between third and fourth spines, often so deeply that the first dorsal is divided into two separate but contiguous fins. First spine often much produced but its length is extremely variable, sometimes as long as head and extending as far as base of seventh dorsal ray; second and third spines abruptly and progressively shorter; the second one usually shorter than longest spine in second part of spinous dorsal in specimens from south of Point Conception; in material from farther

north it is usually longer than any of the succeeding spines. Second part of fin rising to a well-defined angle anteriorly, its postero-dorsal profile forming an abruptly descending convex curve; first or second spine of this part longest, 1.6 (1.3-1.9) in base of entire fin. Second dorsal separated from first dorsal by a short interspace equal to 0.3 or less of diameter of pupil; its origin over first or second anal ray; base of fin 1.0 (0.9-1.1) in anal base. Fin forming a gentle convex curve, somewhat more abruptly rounded posteriorly than anteriorly; longest ray, somewhere between third and ninth, about equal to or somewhat longer than longest spine in second part of first dorsal and 2.1 (1.8-2.4) in base of fin; terminal membrane attached to peduncle under basal 0.4 to 0.7 of depressed last ray. Anal origin about midway between snout and base of caudal in small specimens, midway between anterior orbital margin and caudal base in large ones; its last ray under last or next to last ray of second dorsal; fin similar in shape to second dorsal but markedly lower and with membranes moderately incised. The longest ray, somewhere between the ninth and fifteenth, 2.7 (2.3-3.0) in base of fin; last ray entirely free from peduncle. Base of upper pectoral ray about under or slightly behind base of third dorsal spine; fin extending to a vertical somewhere between second and seventh anal ray; sixth, seventh, or eighth ray longest. Base of fin moderately broad, its width 2.4 (1.9-3.1) in longest ray; fin bluntly pointed; lower membranes moderately incised. Pelvic base midway between snout and a point somewhere between third and sixth anal ray; fin extending to or somewhat beyond anus in large specimens, often not reaching it in small ones; length of fin 1.4 (1.2-1.8) times width of pectoral base; middle ray longest, inner ray shortest. Caudal truncate or slightly rounded, its length 1.5 (1.3-1.8) in anal base.

Measurements in per mille of standard length, based on 50 specimens 54.3 to 143.2 mm. (average 84.9 mm.) in standard length: distance from first dorsal to pelvic 189 (165-209); distance from second dorsal to anal 145 (134-177); depth of caudal peduncle 54 (46-61); width at pectoral base 175 (156-206); length of head 351 (325-397); length of maxillary 182 (167-202); length of snout 92 (82-107); diameter of orbit 107 (94-128); distance from snout to first dorsal 296 (271-323); length of first dorsal 229 (204-258); height of second part of first dorsal 140 (125-163); distance from snout to second dorsal 531 (494-571); length of second dorsal 320 (299-345); height of second dorsal 151 (135-175); distance from snout to anal 519 (484-558); length of anal 319 (299-342); height of anal 118 (107-139); distance from snout to pectoral 327 (297-353); width of pectoral base 114 (94-130); length of longest pectoral ray 270 (241-349); distance from snout to pelvic 298 (270-354); length of pelvic 154 (126-206); length of caudal 208 (182-236).

Fin and scale formulae: D. X(X-XI)—16(14-17); A. 16(14-17); P. 17(16-18); V. I,3; C. 9(9-10); Ll. 38(36-39)+1.

Dorsal ground color brown; back crossed by four, wide, dark bars; occasionally faint and diffuse blotches of similar dark color between cross bars and on nape. Cheeks below suborbital stay blotched with brown and brassy tones; lower part of preopercular border and posterior end of maxillary white; anterior part of upper lip banded with thin whitish bars and broad brown ones; lower lip white at symphysis and posteriorly, a wide blackish bar between; chin and gill membranes white except near opercle where there is some brassy color. Ventral surface of body pearly white on belly, translucent gray posteriorly. First dorsal with faint brown bars on rays, membrane bordered with black. Second dorsal and caudal barred with brown proximally, black distally. Anal colorless or with a broad, horizontal, black bar and a pearly white margin. Pectorals yellow with wide brownish or coppery bars dorsally, a large brownish blotch at base of fin, tips of lower rays pearly white. Pelvics colorless, tipped with white.

I have examined specimens of this species from Puget Sound, Washington; from the following localities in California: off Point Reyes, Lat. 38° 01' 00" N., Long. 123° 09' 00" W.; Lat. 38° 01' 30" N., Long. 123° 06' 00" W.; Lat. 37° 50' 30" N., Long. 122° 57' 00" W.; off Double Point, Lat. 37° 57' 00" N., Long. 122° 50' 30" W.; off Duxbury Point, Lat. 37° 50' 30" N., Long. 122° 45' 00" W.; Monterey Bay, Lat. 36° 43' 00" N., Long. 121° 52' 00" W.; Lat. 36° 39' 45" N., Long. 121° 53' 45" W.; Lat. 36° 39' 30" N., Long. 121° 51' 45" W.; Lat. 36° 39' 00" N., Long. 121° 52' 00" W.; off west end of San Nicolas Island; off east end of San Nicolas Island; two miles off Redondo Beach; off Point Loma, Lat. 32° 35' 00" N., Long. 117° 13' 30" W.; and from the following localities in Lower California: off north end of San Martin Island; off Guadalupe Island, Lat. 28° 58' 30" N., Long. 118° 15' 45" W.; Santa Maria Bay. The known range of the species is from Ucluelet, British Columbia, to Santa Maria Bay, Lower California. It is common on sandy bottoms in from 20 to 58 fathoms and has once been taken at low tide at Ucluelet.

Genus ICELINUS Jordan

ICELINUS Jordan, 1885, p. 110 (genotype by monotypy *Artedius quadriseriatus* Lockington); Bolin, 1936, p. 151.

Lower jaw somewhat shorter than upper, slightly included. Teeth in moderately wide bands on vomer and palatines. Nasal spines moderately strong, sharply pointed. Anterior nostrils in well-developed tubes, their posterior margins produced into pointed valvular flaps; posterior nostrils with slightly elevated rims. Orbits markedly longer than high; upper orbital margins not elevated. Interorbital space narrow, its width not exceeding posterior width of maxillary. Four preopercular spines; the upper one long and antler like, with a simple or bifid tip and from one to five strong recurved barbs along its upper margin; the remaining spines short, simple, becoming progressively longer and more acutely pointed from upper to lower; the upper one directed backward, the middle one backward and downward, the lower one downward and forward. Opercular flap ending in a bluntly rounded point. Gill membranes broadly united, free from isthmus. Gills $3\frac{1}{2}$, no slit behind the last one.

Lateral line forming an abrupt descending arch over tip of opercular flap, then continued in a more gradually descending straight or slightly arched line to merge into the horizontal, straight, posterior half which extends along the body axis. Lateral line armed with large ctenoid scales. A squamous band, two scales in width, extending along back a little below the base of dorsal fins; the upper row usually continued posteriorly beyond the end of lower row by a few scales; first scale of lower row often without a dorsal counterpart. The individual scales are in the form of deeply embedded plates, each bearing an inclined and strongly ctenoid ridge; the ridges of the upper row protrude postero-ventrally, those of the lower row postero-dorsally. Rarely one or two scales between dorsal scale row and lateral line. A varying number of cirri on head and body; always a well-developed flattened cirrus at upper posterior margin of orbit, and one or more cirri on posterior end of maxillary, the latter sometimes very small and inconspicuous. Anus about 0.5 of an orbital diameter, or somewhat more, in advance of anal origin.

First two dorsal spines with approximate bases, the others almost evenly spaced. Second dorsal gently rounded anteriorly, abruptly rounded posteriorly, the main distal profile forming a slightly descending, gentle, convex curve. The anal similar in shape to second dorsal but somewhat lower. Base of pectoral moderately

procurrent; none of its rays branched. Pelvic fins small; I,2; inner ray the longer, not attached to belly by membrane. Caudal truncate or very slightly rounded.

This genus contains eight known species, seven of which occur in California.

KEY TO THE CALIFORNIA SPECIES

1a. Dorsal band of scales not extending beyond end of second dorsal fin.
 2a. A few small scales behind axilla; anal origin under first or second dorsal ray; pelvics moderate, extending more than 0.25 of the distance to anal origin.
  3a. No distinct spines at upper posterior angle of orbit; dorsal scale band extending to end of second dorsal; a long cirrus at base of nasal spine.....(p. 24) I. FILAMENTOSUS.
  3b. Two distinct spines at upper posterior angle of orbit; dorsal scale band not extending to base of last dorsal ray; no cirrus on nasal spine.
   4a. Top of head very gently concave; body slender, distance from dorsal origin to pelvic base less than 0.21 of standard length; second dorsal with 16-19 rays; anal with 14-17 rays..(p. 26) I. TENUIS.
   4b. Top of head marked by an abrupt depression; body robust, distance from dorsal origin to pelvic base more than 0.21 of standard length; second dorsal with 13-15 rays; anal with 11-13 rays.....(p. 28) I. CAVIFRONS.
 2b. No scales behind axilla; anal origin under third or fourth dorsal ray; pelvics small, extending less than 0.25 of the distance to anal origin.....(p. 30) I. BURCHAMI.
1b. Dorsal band of scales continued on dorsal surface of caudal peduncle.
 5a. Dorsal scale band continuous throughout; pelvic fins small, extending less than 0.33 of distance to anal origin.
  6a. A fringe of cirri along posterior end of maxillary; cirrus at base of nasal spine with expanded and fringed tip..(p. 32) I. FIMBRIATUS.
  6b. A single cirrus near posterior end of maxillary; cirrus at base of nasal spine long, slender, simple.....(p. 33) I. OCULATUS.
 5b. Dorsal scale band interrupted for a short space under end of second dorsal; pelvic fins moderate, extending more than 0.33 of distance to anal origin.....(p. 35) I. QUADRISERIATUS.

Subgenus TARANDICHTHYS Jordan and Evermann

TARANDICHTHYS Jordan and Evermann in Jordan, 1896, p. 225 (genotype by original designation *Icelinus filamentosus* Gilbert).

Body very slightly compressed throughout, almost circular in cross section, width at pectoral base 1.1 (1.0-1.3) in distance from dorsal origin to pelvic base.

Dorsal scale band not continued as a definite band beyond end of second dorsal; one or more deeply embedded, flat, ctenoid scales behind axilla. Maxillary cirrus single; a small slender cirrus on middle of suborbital stay. Genital papilla not markedly enlarged in males.

First one or two dorsal spines are long and filamentous, at least in adult

males. Origin of second dorsal on a vertical between anus and anal origin. Anal origin under first or second dorsal ray, its posterior ray under second to fourth ray from end of second dorsal. Free edge of pectoral fin divided into two more or less distinct curves; the upper part bluntly rounded and with the membranes not incised; the lower part with its upper rays a little longer than those directly above, more gently curved than upper part and with membranes deeply incised.

ICELINUS (TARANDICHTHYS) FILAMENTOSUS Gilbert

(Fig. 7)

ICELINUS FILAMENTOSUS Gilbert, 1891, p. 85 (Albatross stations 2893 and 2959 in the Santa Barbara Channel, California); 1895, p. 469.
TARANDICHTHYS FILAMENTOSUS Jordan and Evermann in Jordan, 1896, p. 225, pl. 28; Jordan and Evermann, 1898a, p. 1892; Starks and Morris, 1907, p. 218; Evermann and Goldsborough, 1907, p. 297; Gilbert, 1915, p. 339.
TARANDICHTHYS FILAMENTOSIS Ulrey, 1929, p. 9.

Body slightly more robust in old specimens than in young individuals, heavy anteriorly; distance from dorsal origin to pelvic base 4.3 (3.6-5.2) in standard length; caudal peduncle rather slender, its depth 1.6 (1.2-2.1) in diameter of orbit.

Head large, 2.7 (2.5-2.9) in standard length. Mouth moderate; maxillary extending to a point somewhere under pupil, its length 2.5 (2.3-2.7) in head. Snout steep, rather long, 1.1 (0.8-1.3) in orbit. Nasal spines about in line with profile of snout. Eye of moderate size, orbit 3.4 (3.0-4.1) in head. Interorbital space shallowly grooved, its width increasing with age and 1.2 (1.0-1.5) in width of maxillary. Top of head concave between the low, rounded, fronto-parietal ridges which terminate in short spines in young individuals, in blunt knobs in old ones. These ridges, smooth during youth, become roughened and marked by low obtuse elevations with advancing age. No spines at upper posterior margin of orbit, and none on posttemporal. Upper preopercular spine 1.2 (1.1-1.4) in orbit, with three to five barbs on upper margin. A very small spinous point at lower angle of subopercle, covered by skin but readily located by touch in alcoholic specimens. Opercular flap extending about 0.7 to 0.9 of an orbital diameter behind upper end of gill opening. Anterior pores of mandibular latero-sensory canal opening in a common median pit.

Dorsal scale band extending from third or fourth dorsal spine to end of second dorsal; usually double throughout with 30 (27-33) scales in each row; rarely with a single widely spaced scale slightly behind base of last dorsal ray. Two to six scales in axilla. Maxillary cirrus long and prominent. A long slender cirrus at base of the nasal spine and sometimes a small one on its tip. Usually a small cirrus on eyeball. Postorbital cirrus large, with expanded tip and slightly fringed edges, its length equal to or greater than diameter of pupil. A well-developed cirrus on middle of fronto-parietal ridge and one at its posterior end. Usually a simple or double cirrus at base of each of the simple preopercular spines. A simple cirrus in front of dorsal end of gill opening and a single or double one on base of opercular flap. Sometimes a single minute cirrus behind opercular flap midway between upper end of pectoral base and lateral line. Single or double cirri on from four to seven of the lateral-line scale margins.

Origin of first dorsal a little in advance of upper end of gill opening; base of fin 1.4 (1.2-1.6) in base of second dorsal; first two spines, and sometimes

the third, filamentous, very variable in length, often reaching beyond end of the second dorsal, their produced portions not connected by membrane; distal profile of unproduced part of fin forming a descending convex curve which merges into the almost perpendicular posterior margin by means of a bluntly rounded angle at tip of third or fourth spine from end of fin. Longest nonfilamentous ray, somewhere between third and fifth, 1.5 (1.3-2.1) in base of fin. Second dorsal contiguous to or separated from first dorsal by a very short interspace; longest ray, somewhere between sixth and tenth, equal to or somewhat longer than longest unproduced dorsal spine and 1.9 (1.3-2.3) in base of fin; terminal membrane involving only about the basal 0.1 of last ray. Base of anal 1.2 (1.1-1.4) in base of second dorsal; longest ray, somewhere between sixth and tenth, 2.1 (1.5-2.7) in base of fin; last ray entirely free from caudal peduncle. In very old specimens a few of the posterior rays of second dorsal and anal are branched. Base of upper pectoral ray under third to fifth dorsal spine; fin extending to a vertical somewhere between second and fifth anal ray; ninth or tenth ray longest; the base of fin moderately broad, its width 2.3 (1.8-2.6) in longest ray. Pelvic base midway between snout and a point somewhere between first and third anal ray; fin extending about 0.3 or 0.4 of the distance to anal origin, its length 1.4 (1.1-1.7) in width of pectoral base. Length of caudal 1.4 (1.2-1.6) in anal base.

Measurements in per mille of standard length, based on 50 specimens 51.1 to 201.0 mm. (average 122.8 mm.) in standard length: distance from first dorsal to pelvic 228 (194-277); distance from second dorsal to anal 172 (143-204); depth of caudal peduncle 68 (57-77); width at pectoral base 211 (178-254); length of head 368 (350-394); length of maxillary 146 (134-164); length of snout 104 (91-122); diameter of orbit 109 (91-125); distance from snout to first dorsal 299 (280-326); length of first dorsal 240 (210-274); height of unproduced part of first dorsal 153 (120-180); distance from snout to second dorsal 523 (507-541); length of second dorsal 341 (314-365); height of second dorsal 176 (150-242); distance from snout to anal 523 (498-561); length of anal 295 (259-316); height of anal 137 (110-200); distance from snout to pectoral 330 (309-354); width of pectoral base 118 (100-139); length of longest pectoral ray 265 (239-286); distance from snout to pelvic 277 (253-311); length of pelvic 85 (74-114); length of caudal 220 (188-237).

Fin and scale formulae: D. X(IX-XI)—16(15-17); A. 14(13-15); P. 17(16-18); V. I,2; C. 9(9-10); Ll. 38(37-39)+1(1-2).

Color pinkish brown above, with four faint gray cross bars and a blotch of similar color at base of caudal. Ground color faintly speckled with small, irregular, whitish spots; larger white spots extending in two irregular and broken bands immediately above and below lateral line. Dark cross bars marked by a few brown spots which fade to orange yellow at margins. Lateral line with similar but more diffuse spots. Body below lateral line smoky gray, whitish ventrally. Head mottled with brown and gray; whitish lines across upper lip and radiating from eye; white vermiculations on cheek. Lower lip and chin white; gill membranes dusky. Dorsal and caudal fins barred with pale lemon yellow and pinkish or orange brown. Anal white with dusky margin. Pectorals pale yellow, barred with brown or black, lower basal portion blackish. Pelvics practically colorless with a dash of black at base.

I have examined specimens of this species from Georgia Strait, British Columbia, Lat. 49° 20' 30" N., Long. 123° 43' 00" W.; from Hood Canal, Washington; and from the following localities in California: off Point Reyes, Lat. 37° 59' 40" N., Long. 123° 14' 25" W.; off Noonday Rock, Lat. 37° 49' 30" N., Long. 123° 23' 40" W.; off Needle Rock Point, Lat. 36° 52' 00" N., Long. 122° 11' 00" W.; off Point Santa Cruz, Lat. 36° 48' 30" N., Long. 122° 07' 15" W.; Monterey Bay, Lat. 36° 49' 00" N., Long. 121° 58' 45" W.; Lat. 36° 44' 20" N., Long. 121° 56' 50" W.;

Lat. 36° 44' 00" N., Long. 121° 58' 00" W.; Lat. 36° 43' 45" N., Long. 121° 57' 45" W.; Lat. 36° 43' 20" N., Long. 121° 57' 00" W.; Lat. 36° 43' 30" N., Long. 121° 58' 35" W.; Lat. 36° 41' 30" N., Long. 121° 58' 15" W.; Monterey markets; off Point Lobos, Lat. 36° 31' 00" N., Long. 121° 59' 00" W.; off Soberanes Point, Lat. 36° 26' 40" N., Long. 122° 00' 05" W.; off Richardson Rock, Lat. 34° 12' 30" N., Long. 120° 32' 30" W. (two syntypes); off San Miguel Island, Lat. 34° 06' 45" N., Long. 120° 18' 00" W. (one syntype); Santa Barbara markets; Santa Monica Bay, Lat. 33° 58' 00" N., Long. 118° 38' 00" W.; off Avalon, Santa Catalina Island; off Point Loma, Lat. 32° 34' 00" N., Long. 117° 21' 30" W. The recorded range of this species is from the Strait of Georgia, British Columbia, to off Point Loma, California. It is known from depths between 18 and 204 fathoms and is not uncommon on sandy or muddy bottoms.

ICELINUS (TARANDICHTHYS) TENUIS Gilbert

(Fig. 8)

ICELINUS TENUIS Gilbert, 1891, p. 86 (Albatross stations 2893, 2946, 2959, 2977, and 2983, in the Santa Barbara Channel, California, and off Guadalupe Island, Lower California); 1895, p. 468.

TARANDICHTHYS TENUIS Jordan and Evermann, 1896, p. 436; 1898a, p. 1893; Gilbert, 1899, p. 26; Starks and Morris, 1907, p. 218; Evermann and Goldsborough, 1907, p. 297; Gilbert, 1915, p. 339.

TARANDICHTHYS TENUS Schultz and DeLacy, 1936a, p. 78.

Body slender throughout; distance from dorsal origin to pelvic base 5.6 (5.0-6.2) in standard length. Depth of caudal peduncle 1.8 (1.4-2.3) in orbit.

Head small, its length 3.2 (2.9-3.5) in standard length. Mouth of moderate size; maxillary extending to a vertical somewhere under the pupil, its length 2.4 (2.1-2.7) in head. Snout moderately steep and long, its length 1.1 (0.9-1.4) in orbit. Nasal spines about in line with profile of snout, or somewhat more erect. Eye of moderate size; orbit 3.2 (2.6-3.6) in head. Interorbital space flat or very slightly concave, its width 2.2 (2.0-2.9) in width of maxillary. Top of head gently concave between the low fronto-parietal ridges which terminate in sharp spines almost as strong as nasal spines. Two similar spines behind upper posterior margin of orbit and a smaller spine on posttemporal. Upper preopercular spine 1.8 (1.6-2.0) in orbit, with two or three barbs on upper margin. No spinous point on subopercle. Opercular flap extending about 0.5 to 0.7 of an orbital diameter behind upper end of gill opening. Anterior pores of the mandibular latero-sensory canal usually opening in a common median pit.

Dorsal scale band extending from fourth or fifth dorsal spine to somewhere between fifth and eleventh dorsal ray; about 16 (9-21) scales in each row. From five to 19 scales in axilla. Maxillary cirrus small. No nasal cirri, nor any cirri on eyeball. Postorbital cirrus usually ribbon like and not markedly expanded at tip, its length about equal to width of maxillary. A long slender cirrus on middle of fronto-parietal ridge; none at its posterior end. Frequently a small cirrus on one or more of the simple preopercular spines. A well-developed simple or double cirrus on base of opercular flap. Very rarely a single minute cirrus behind opercular flap midway between upper end of pectoral base and lateral line. Usually a single cirrus on from one to ten of the scale margins of the lateral line; rarely these are totally absent.

Origin of first dorsal directly over or slightly in advance of upper end of

gill opening; base of fin 1.7 (1.5-2.1) in base of second dorsal. First two spines filamentous, the first sometimes reaching the base of last dorsal ray, the second usually much shorter; the second spine sometimes connected to first by membrane for most of its length, sometimes not above tip of the third spine. Distal profile of unproduced part of fin forming an almost straight descending line; posterior margin almost vertical, the two portions usually meeting in a sharp angle; longest nonfilamentous spine, somewhere between third and sixth, 1.5 (1.1-2.1) in base of fin. Second dorsal separated from first dorsal by a short interspace equal to about 0.5 maxillary width; longest ray, somewhere between the sixth and fourteenth, usually markedly longer than nonfilamentous dorsal spines and 2.2 (1.6-2.6) in base of fin; terminal membrane attached to peduncle under basal 0.1 or 0.2 of depressed last ray. Base of anal 1.1 (1.0-1.2) in base of second dorsal; longest ray, somewhere between seventh and twelfth, 2.4 (1.8-3.0) in base of fin; last ray entirely free from peduncle. In large individuals a few of the posterior rays of second dorsal and anal are branched. Base of upper pectoral ray about under third dorsal spine; fin extending to a vertical somewhere between third and sixth anal ray; eighth or ninth ray longest. Base of fin narrow, 2.9 (2.4-3.3) in longest ray. Pelvic base midway between snout and a point somewhere between tip of genital papilla and third anal ray; fin extending about 0.3 of distance to anal origin, its length 1.2 (1.0-1.6) in width of pectoral base. Length of caudal 1.7 (1.5-2.0) in anal base.

Measurements in per mille of standard length, based on 38 specimens 44.5 to 127.0 mm. (average 89.3 mm.) in standard length: distance from first dorsal to pelvic 178 (161-200); distance from second dorsal to anal 146 (132-160); depth of caudal peduncle 56 (49-63); width at pectoral base 166 (148-195); length of head 310 (282-343); length of maxillary 127 (110-147); length of snout 88 (73-104); diameter of orbit 97 (82-119); distance from snout to first dorsal 264 (244-279); length of first dorsal 218 (186-242); height of unproduced part of first dorsal 140 (104-173); distance from snout to second dorsal 473 (443-503); length of second dorsal 368 (336-427); height of second dorsal 172 (133-213); distance from snout to anal 469 (436-503); length of anal 326 (299-361); height of anal 132 (108-169); distance from snout to pectoral 290 (264-326); width of pectoral base 95 (82-117); length of longest pectoral ray 279 (240-312); distance from snout to pelvic 250 (202-322); length of pelvic 78 (62-95); length of caudal 195 (169-220).

Fin and scale formulae: D. X(IX-XI)—18(16-19); A. 16(13-17); P. 16(15-17); V. I,2; C. 9(9-10); Ll. 40(38-42)+1.

Upper ground color of head and body greenish orange vermiculated with pale bluish white. Back crossed by four diffuse darker cross bars. Ventral surface of chin and posterior part of body translucent white; belly pearly white. Dorsal and caudal fins barred with brown; a diffuse black spot on middle of first dorsal. Pectorals suffused with lemon yellow, barred with brown, and with a large brown spot at base of fin. Pelvics and anal colorless.

I have examined specimens of this species from the following localities: British Columbia: Queen Charlotte Sound off Fort Rupert; Georgia Strait, Lat. 49° 20' 30" N., Long. 123° 43' 00" W.; Departure Bay; Washington: Holly Bay, the Hood Canal; Hood Canal off Dillman Point; California: off Point Reyes, Lat. 37° 56' 40" N., Long. 123° 25' 30" W.; off Pillar Point, Lat. 37° 21' 00" N., Long. 122° 51' 00" W.; off Point Santa Cruz, Lat. 36° 48' 30" N., Long. 122° 07' 15" W.; from Monterey Bay, Lat. 36° 49' 00" N., Long. 121° 58' 45" W.; Lat. 36° 48' 30" N., Long. 121° 58' 45" W.; Lat. 36° 44' 00" N., Long. 121° 58' 00" W.; Lat. 36° 43' 30" N., Long. 121° 58' 35" W.; Lat. 36° 43' 45" N., Long. 121° 58' 00" W.; Lat. 36° 41' 30" N., Long. 121° 58' 15" W.; off Point Joe, Lat. 36° 37' 50" N., Long. 122° 00' 35" W.; off Point San Luis; off Richardson Rock, Lat. 34° 12' 30" N., Long.

120° 32' 30" W. (four syntypes); off San Miguel Island, Lat. 34° 06' 45" N., Long. 120° 18' 00" W. (five syntypes); off Santa Rosa Island, Lat. 33° 55' 30" N., Long. 119° 55' 00" W.; Lower California: off Guadalupe Island, Lat. 28° 58' 30" N., Long. 118° 15' 45" W. (four syntypes). The known range of this species is from Queen Charlotte Sound to Guadalupe Island. It is not rare on sandy bottoms in from 18 to 204 fathoms.

ICELINUS (TARANDICHTHYS) CAVIFRONS Gilbert

(Fig. 9)

ICELINUS CAVIFRONS Gilbert, 1891, p. 83 (Albatross stations 2907 and 2945, in the Santa Barbara Channel, California); Bolin, 1936, p. 155.

TARANDICHTHYS CAVIFRONS Jordan and Evermann, 1896, p. 436; 1898a, p. 1891; Starks and Morris, 1907, p. 218; Starks and Mann, 1911, p. 15; Fowler, 1923a, p. 299; Ulrey and Greeley, 1928, p. 14.

Body heavy anteriorly, distance from dorsal origin to pelvic base 4.4 (4.1-4.7) in standard length; caudal peduncle rather slender, its depth 1.7 (1.4-2.0) in orbit.

Head moderate in size, its length 2.7 (2.6-2.8) in standard length. Mouth rather small; maxillary extending to a vertical somewhere between anterior rim of orbit and posterior margin of pupil, its length 2.6 (2.4-2.8) in head. Snout steep and moderately long, its length 1.1 (0.9-1.5) in orbit. Nasal spines erect, protruding strongly above profile of snout. Eye moderate in size; orbit 3.2 (2.9-3.6) in head. Interorbital space very shallowly grooved, its width 1.6 (1.3-2.0) in width of maxillary. Top of head marked by an abrupt depression about as large as pupil; this bounded laterally by the short, high, fronto-parietal ridges which terminate in well-developed spines. Two strong and acute spines behind upper posterior margin of orbit; a smaller and flatter spine on posttemporal. Upper preopercular spine 1.5 (1.3-1.6) in orbit, with one to five barbs on upper margin. A short spinous point on lower angle of subopercle. Opercular flap extending about 0.4 or 0.5 of an orbital diameter behind upper end of gill opening. Anterior pores of mandibular latero-sensory canal usually opening in a median pit, rarely opening separately on either side of symphysis.

Dorsal scale band about 20 (18-22) scales long, extending from fifth or sixth dorsal spine to somewhere between eleventh and fourteenth dorsal ray. From one to five scales in axilla. Maxillary cirrus small. No cirri on nasal spine. Usually one or more small cirri on eyeball, these often minute, sometimes absent. Postorbital cirrus of moderate size, its length usually about equal to width of maxillary, rarely very small; ribbon or paddle shaped, the expansion of tip variable; sometimes fringed. No cirri on fronto-parietal ridge; sometimes a small cirrus on one of the preopercular spines; usually a small cirrus on base of opercular flap. A single cirrus on from two to nine of the lateral-line scale margins.

Origin of first dorsal directly over or slightly in advance of upper end of gill opening; base of fin 1.3 (1.1-1.5) in base of second dorsal. First one or two spines filamentous in adult males, very variable in length, often extending to middle of second dorsal, the filamentous portions not connected by membrane. First dorsal spines of females not filamentous; the fin with a well-defined anterior angle, bluntly rounded posteriorly, the main portion of the distal profile forming a slightly curved descending line. Longest nonfilamentous spine, somewhere between second and fifth, 1.4 (1.1-1.8) in base of fin. Second dorsal contiguous to first dorsal or separated from it by a very narrow interspace; longest ray, somewhere between third and seventh, usually a little longer than unproduced dorsal spines.

and 1.7 (1.4-2.0) in base of fin. Last ray entirely free from peduncle or joined to it by membrane at extreme base only. Anal base 1.2 (1.1-1.3) in base of second dorsal; longest ray, somewhere between fourth and tenth, usually somewhat shorter than longest unproduced dorsal spine and 2.0 (1.8-2.3) in base of fin; last ray entirely free from peduncle. None of the dorsal nor anal rays branched. Base of upper pectoral ray about under third dorsal spine; fin extending to a vertical somewhere between first and fourth anal ray; eighth ray longest. Base of fin 2.5 (2.1-3.0) in longest ray. Pelvic base midway between snout and third or fourth anal ray; fin extending about 0.4 or 0.5 of the distance to anal origin, its length 1.0 (0.8-1.1) in width of pectoral base. Length of caudal 1.1 (0.9-1.2) in length of anal base.

Measurements in per mille of standard length, based on 16 specimens 20.6 to 66.0 mm. (average 49.9 mm.) in standard length: distance from first dorsal to pelvic 229 (211-246); distance from second dorsal to anal 170 (142-191); depth of caudal peduncle 68 (55-83); width at pectoral base 200 (180-236); length of head 365 (351-380); length of maxillary 138 (124-155); length of snout 104 (87-114); diameter of orbit 117 (101-128); distance from snout to first dorsal 321 (295-350); length of first dorsal 231 (197-254); height of unproduced part of first dorsal 157 (139-204); distance from snout to second dorsal 535 (508-560); length of second dorsal 296 (264-324); height of second dorsal 167 (154-180); distance from snout to anal 534 (499-557); length of anal 247 (223-267); height of anal 123 (106-148); distance from snout to pectoral 336 (294-352); width of pectoral base 117 (103-130); length of longest pectoral ray 291 (254-328); distance from snout to pelvic 292 (262-329); length of pelvic 116 (105-127); length of caudal 224 (212-238).

Fin and scale formulae: D. X(IX-X)—14(13-15); A. 12(11-13); P. 15(14-16); V. I,2; C. 9; Ll. 37(36-38)+1.

Color extremely variable; dorsal parts olivaceous to coral red; back with three dark cross bars and a blotch of similar color at base of caudal. Dorsal scale bands usually tinged with vermillion; lateral line marked by whitish spots. Sides of body below lateral line reddish or brownish with round white spots; ventral area pearly white. Dorsal fins irregularly barred with reddish brown; caudal barred with red; anal very lightly barred with pale brown. Pectorals with brown and pale orange bars and a prominent, black, basal spot; base of pelvics blackish.

I have examined specimens of this species from the following localities in California: off Del Monte; Monterey Bay, Lat. 36° 36' 30" N., Long. 121° 53' 00" W.; off San Augustin, Lat. 34° 24' 30" N., Long. 120° 20' 00" W. (five syntypes); Anacapa Passage, Lat. 34° 00' 00" N., Long. 119° 29' 30" W. (six syntypes); and from the following localities in Lower California: east of Los Coronados Islands, Lat. 32° 24' 00" N., Long. 117° 09' 15" W.; off San Martin Island; Santa Maria Bay. The recorded range of this species is from Monterey Bay, California, to Santa Maria Bay, Lower California. It occurs on sandy bottoms in water from six to 50 fathoms deep, but is nowhere common.

Subgenus MEDICELINUS Bolin

MEDICELINUS Bolin, 1936, p. 156 (genotype by original designation *Icelinus burchami* Evermann and Goldsborough).

Dorsal scale band not continued beyond end of second dorsal, no scales on upper surface of caudal peduncle; no scales behind axilla. Genital papilla of males not enlarged and modified into a penis.

Anterior spines of first dorsal of moderate length, not filamentous.

ICELINUS (MEDICELINUS) BURCHAMI Evermann and Goldsborough

(Fig. 10)

ICELINUS BURCHAMI Evermann and Goldsborough, 1907, p. 297, fig. 48 (Albatross station 4228, Behm Canal, Alaska).
ICELINUS FUSCESCENS Gilbert, 1915, p. 340, pl. 17, fig. 9 (Albatross station 4418, off Santa Barbara Island, California).

Body rather heavy, moderately compressed behind pectoral fins, oval rather than subcircular in cross section; width at pectoral base 1.1 (1.0-1.2) in distance from dorsal origin to pelvic base. Depth of caudal peduncle 1.9 (1.5-2.5) in orbit.

Head large 2.7 (2.4-3.1) in standard length. Mouth rather large; maxillary extending to a vertical somewhere between middle and posterior margin of pupil or sometimes even slightly beyond the latter point, its length 2.2 (1.9-2.4) in head. Snout moderately steep, rather short, its length 1.4 (1.1-1.8) in orbit. Nasal spines not strongly erect, about in line with profile of snout. Eye large, orbit 3.0 (2.7-3.5) in head. Interorbital space flat and narrow, its width about 1.6 in width of maxillary. Top of head flat or very gently concave; fronto-parietal ridges almost absent, their terminal spines represented by low flat elevations; no spines near orbit nor on posttemporal. Upper preopercular spine 1.8 (1.6-2.0) in orbit, with two to four barbs on its upper margin. No spine on subopercle. Opercular flap extending about 0.4 or 0.5 of an orbital diameter behind upper end of gill opening. Anterior pores of mandibular latero-sensory canal usually opening separately on either side of symphysis, rarely opening into a single median pit.

Dorsal scale band about 23 (18-29) scales long, extending from fifth, sixth, or seventh dorsal spine to last or next to last dorsal ray. Maxillary cirrus small, simple. Postorbital cirrus well developed, ribbon shaped or with slightly expanded tip, sometimes branched, its length about equal to width of maxillary. A long and slender cirrus on middle of fronto-parietal ridge and another at its posterior end. Usually a small and inconspicuous cirrus on suborbital stay and a similar one just in front of upper end of gill opening. One or two small cirri on base of opercular flap.

Origin of first dorsal slightly in advance of upper end of gill opening, base of fin 1.5 (1.4-2.0) in base of second dorsal; longest spine, somewhere between third and fifth, 1.6 (1.4-1.9) in base of fin. Second dorsal contiguous to first dorsal or separated from it by a very narrow interspace; its origin directly over or slightly in advance of anus; longest ray, somewhere between seventh and eleventh, markedly longer than longest dorsal spine and 2.2 (2.0-2.4) in base of fin; terminal membrane attached to peduncle under basal 0.1 to 0.3 of depressed last ray. Anal origin under third or fourth dorsal ray, its last ray under second or third ray from end of second dorsal; base of fin 1.3 (1.2-1.5) in base of second dorsal; longest ray, somewhere between sixth and eighth, rarely equal to, usually much shorter than longest dorsal spine and 1.9 (1.6-2.3) in base of fin; terminal membrane attached to peduncle under basal 0.2 to 0.4 of depressed last ray. None of the dorsal nor anal rays branched. Base of upper pectoral ray under third or fourth dorsal spine; fin extending to a vertical somewhere between anus and anal origin; eighth, ninth, or tenth ray longest. Base of fin broad, 2.0 (1.7-2.2) in longest ray; the free edge of fin divided into two more or less distinct curves; the upper part bluntly rounded and with membranes not incised; the lower part with its upper rays a little longer than those directly above, more gently curved than upper part and with membranes deeply incised. Pelvic base midway between snout and anal origin

or slightly in advance of this point; fin extending only 0.1 or 0.2 of the distance to anal origin; its length 2.4 (1.6-3.5) in width of pectoral base. Length of caudal 1.3 (1.1-1.4) in anal base.

Measurements in per mille of standard length, based on 23 specimens 36.6 to 107.5 mm. (average 68.1 mm.) in standard length: distance from first dorsal to pelvic 209 (186-250); distance from second dorsal to anal 156 (126-182); depth of caudal peduncle 68 (57-81); width at pectoral base 185 (159-217); length of head 380 (324-424); length of maxillary 171 (157-191); length of snout 91 (78-110); diameter of orbit 128 (110-150); distance from snout to first dorsal 326 (302-352); length of first dorsal 212 (180-254); height of first dorsal 130 (115-154); distance from snout to second dorsal 529 (505-560); length of second dorsal 341 (316-370); height of second dorsal 160 (142-180); distance from snout to anal 576 (554-613); length of anal 259 (226-283); height of anal 129 (104-143); distance from snout to pectoral 354 (337-380); width of pectoral base 136 (123-149); length of longest pectoral ray 270 (210-324); distance from snout to pelvic 288 (264-316); length of pelvic 60 (42-82); length of caudal 204 (190-224).

Fin and scale formulae: D. IX(IX-X)—17(16-18); A. 13(12-14); P. 18(16-19); V. I,2; C. 9; Ll. 37(35-38)+1.

Ground color light olive green; back crossed by about five darker olive-brown bars which tend to be outlined by thin lines of very pale lavender gray. An ill-defined dark streak over head, crossing eyes and extending on suborbital and maxillary. Lips barred with olive brown and bluish gray. Ventral surfaces of head and body dark smudgy gray. Dorsal and caudal fins coarsely and irregularly barred with broad lines of blackish gray and narrow lines of gray green. Anal gray, lighter proximally than distally. Pectorals barred with blackish gray and greenish yellow, darker at base than at tip, lower rays white. Ventrals white.

I have examined specimens of this species from Behm Canal, Alaska, Lat. 55° 36' 00" N., Long. 131° 42' 45" W. (the holotype and three paratypes); from Hood Canal off Holly Bay, Washington; and from the following localities in California: off Point Pinos, Lat. 36° 42' 30" N., Long. 121° 59' 30" W. (one paratype of *I. fuscescens*); off Point Sur, Lat. 36° 20' 45" N., Long. 122° 06' 15" W.; off Santa Catalina Island, Lat. 33° 23' 50" N., Long. 118° 18' 40" W. (one paratype of *I. fuscescens*); off Santa Barbara Island, Lat. 33° 21' 20" N., Long. 119° 04' 00" W. (the holotype and one paratype of *I. fuscescens*); off San Nicolas Island, Lat. 33° 10' 30" N., Long. 119° 23' 30" W. (six paratypes of *I. fuscescens*). The first and last of these localities represent the known limits of distribution for the species. It appears to be a rather uncommon form in depths of from 134 to 238 fathoms, and it seems to frequent all types of bottom.

Subgenus PENICELINUS Bolin

PENICELINUS Bolin, 1936, p. 156 (genotype by original designation *Icelinus fimbriatus* Gilbert).

Head very large; mouth with a wide gape, the maxillary extending to a vertical somewhere between posterior margin of pupil and posterior edge of orbit. Top of head gently concave between low, rounded, fronto-parietal ridges which terminate in short spines or low elevations. Two or rarely three similar spines behind upper posterior margin of orbit, these sometimes so reduced that they are difficult to locate; no spine on posttemporal. A very small spinous point on lower angle of subopercle. Anterior pores of mandibular latero-sensory canal opening separately on either side of the symphysis.

Dorsal scale row continued beyond end of second dorsal by a single row of from three to five scales on each side of dorsal surface of caudal peduncle. No axillary scales. Genital papilla of males developed into a large bluntly conical penis.

Origin of first dorsal a little in advance of upper end of gill opening; anterior dorsal spines not produced and filamentous. Second dorsal contiguous to first dorsal or separated from it by a very short interspace, its origin on a vertical between anus and anal origin. Anal origin about under second dorsal ray, its posterior end under second, third, or fourth ray from end of second dorsal. Base of upper pectoral ray under third or fourth dorsal spine; fin bluntly rounded, the longest ray not abruptly longer than those immediately above it; membranes of lower fin margin deeply incised.

ICELINUS (PENICELINUS) FIMBRIATUS Gilbert

(Fig. 11)

ICELINUS FIMBRIATUS Gilbert, 1891, p. 87 (Albatross stations 2893 and 2975 in the Santa Barbara Channel, California); Bolin, 1936, p. 157.

Body heavy and robust, very slightly compressed, subcircular in cross section; width at pectoral base 1.0 (1.0-1.1) in distance from dorsal origin to pelvic base. Caudal peduncle moderately heavy, its depth 1.4 (1.3-1.5) in orbit.

Length of head 2.4 (2.3-2.5) in standard length. Length of maxillary 2.3 (2.1-2.5) in head. Snout steep and long, its length 1.2 (1.1-1.3) times diameter of orbit. Nasal spines about in line with profile of snout. Eye moderate in size; orbit 4.1 (3.9-4.5) in head. Interorbital space grooved, its width about 2.1 in width of maxillary. Upper preopercular spine 1.6 (1.4-1.8) in orbit, with two to four barbs on upper margin. Opercular flap extending from 0.8 to a full orbital diameter behind upper end of gill opening.

Double part of dorsal scale band about 30 (28-33) scales in length, extending from second or third dorsal spine to or slightly beyond base of last dorsal ray, at which point the band becomes single. A fringe of about six well-developed single or double cirri on end of maxillary; one to four cirri on lower margin of suborbital; sometimes small cirri on pore margins of mandibular latero-sensory canal. A large cirrus with palmate tip at base of nasal spine, and frequently one or two small cirri on tip of spine. One to five well-developed cirri on eyeball, these sometimes with expanded and fringed tips. Length of postorbital cirrus about equal to width of maxillary; its tip expanded and fringed. Frequently a few slender cirri scattered irregularly in interorbital space, between fronto-parietal ridges, and behind orbits. Single or double cirri usually present on postorbital spines; similar cirri midway on fronto-parietal ridge and at its posterior end. Two or three simple or double cirri midway on suborbital stay, one of them usually expanded and fringed at tip. Usually one or two cirri on each of the simple preopercular spines; frequently others on preopercular border between the spines and sometimes small ones just anterior to base of upper spine. One or two cirri at upper end of gill opening and a tuft of cirri on base of opercular flap. One or more simple or compound cirri behind opercular flap midway between upper end of pectoral base and lateral line. Tufts of cirri on from 13 to 22 of the lateral-line scale margins. Small cirri or banner-like flaps on tips of most of the spines of first dorsal.

Base of first dorsal 1.3 (1.2-1.4) in base of second dorsal; fin with a sharp anterior angle, truncate posteriorly, the distal profile slightly convex;

longest spine, somewhere between third and sixth, 1.8 (1.7-2.0) in base of fin. Longest ray of second dorsal, somewhere between fourth and eighth, markedly longer than longest dorsal spine and 1.9 (1.7-2.3) in base of fin; the terminal membrane attached to peduncle under basal 0.1 or 0.2 of depressed last ray. Anal base 1.3 (1.2-1.4) in base of second dorsal; longest ray, somewhere between sixth and ninth, equal to or slightly shorter than longest dorsal spine and 1.9 (1.8-2.1) in base of fin; last ray entirely free from peduncle. Often a number of the middle posterior rays of second dorsal and anal are branched. The pectoral fin extending to a vertical somewhere between first and fourth anal ray; longest ray somewhere between seventh and tenth; base of fin broad, 1.8 (1.5-1.9) in longest ray. Pelvic base midway between snout and a point somewhere between first and third anal ray; fin extending about 0.3 of the distance to anal origin, its length 1.8 (1.5-1.9) in width of pectoral base. Length of caudal 1.2 (1.1-1.2) in anal base.

Measurements in per mille of standard length, based on six specimens 110.2 to 150.0 mm. (average 136.6 mm.) in standard length: distance from first dorsal to pelvic 216 (204-230); distance from second dorsal to anal 176 (152-191); depth of caudal peduncle 72 (70-74); width at pectoral base 206 (191-223); length of head 416 (404-432); length of maxillary 180 (170-188); length of snout 121 (114-131); diameter of orbit 101 (93-107); distance from snout to first dorsal 331 (319-342); length of first dorsal 250 (233-261); height of first dorsal 139 (132-149); distance from snout to second dorsal 556 (537-569); length of second dorsal 322 (315-329); height of second dorsal 167 (145-188); distance from snout to anal 548 (529-566); length of anal 251 (229-266); height of anal 129 (115-137); distance from snout to pectoral 365 (350-387); width of pectoral base 137 (132-147); length of longest pectoral ray 242 (210-252); distance from snout to pelvic 288 (273-300); length of pelvic 74 (60-86); length of caudal 212 (195-234).

Fin and scale formulae: D. X—16(15-16); A. 13(12-13); P. 17(16-18); V. I,2; C. 9; Ll. 36(36-37)+1.

General ground color pale olive brown speckled with small irregular yellowish-green spots which become more prominent just below lateral line. Back crossed by five broad bars of dark brown. Lips brown, the upper one crossed by narrow yellow lines, the lower one by wider white ones. Ventral surfaces silvery white; gill membranes colorless or dusky. Dorsal, caudal and pectoral fins yellowish green, heavily barred with brown. Anal barred with black. Pelvic fins colorless or blackish.

I have examined specimens of this species from the following localities in California: Monterey Bay, Lat. 36° 38' 25" N., Long. 121° 53' 00" W.; Lat. 36° 38' 05" N., Long. 121° 53' 30" W.; off Richardson Rock, Lat. 34° 12' 30" N., Long. 120° 32' 30" W. (one syntype); off Santa Cruz Island, Lat. 34° 01' 30" N., Long. 119° 29' 00" W. (one syntype). This species is a rare form known only from Monterey Bay and the region of the Santa Barbara Channel. It occurs on soft bottoms in depths of from 33 to 145 fathoms.

ICELINUS (PENICELINUS) OCULATUS Gilbert

(Fig. 12)

ICELINUS OCULATUS Gilbert, 1891, p. 87 (Albatross station 2935 off Ocean Beach, California); Bolin, 1936, p. 157.

Body rather heavy anteriorly, strongly tapered posteriorly, moderately compressed, oval in cross section; width at pectoral base 1.3 (1.2-1.5) in distance

from dorsal origin to pelvic base. Caudal peduncle slender, its depth 1.9 (1.7-2.0) in diameter of orbit.

Length of head 2.5 (2.4-2.6) in standard length. Length of maxillary 2.3 (2.2-2.4) in head. Snout moderately steep and long, its length 1.0 (0.9-1.1) in the orbit. Nasal spines about in line with profile of snout. Eye large, orbit 3.7 (3.4-4.0) in head. Interorbital space very shallowly grooved or practically flat, its width 3.0 (2.2-3.3) in width of maxillary. Upper preopercular spine about 2.1 (1.7-2.4) in orbit, with two or three barbs on upper margin. Opercular flap extending 0.6 or 0.7 of an orbital diameter behind upper end of gill opening.

Double part of dorsal scale band about 33 (30-36) scales in length, extending from second or third dorsal spine to just beyond end of second dorsal, at which point the band becomes single. Maxillary cirrus single. Nasal cirrus simple, about twice as long as nasal spine. Usually one or two long slender cirri on eyeball. Postorbital cirrus with expanded tip, its length about equal to diameter of pupil. Usually a simple or branched cirrus midway on fronto-parietal ridge and a similar one at its posterior end. Usually a long slender cirrus on suborbital stay and a similar one on one or more of the simple preopercular spines. Usually a simple cirrus at dorsal end of gill opening and another on base of opercular flap. Often a single cirrus behind opercular flap midway between upper end of pectoral base and lateral line. From six to nine of the lateral-line scale margins bearing one or two simple cirri.

Base of first dorsal 1.4 (1.4-1.5) in base of second dorsal; fin with a marked anterior angle, the distal profile convex, more strongly rounded posteriorly; third, fourth, or fifth spine longest and 1.7 (1.5-2.0) in base of fin. Longest ray of second dorsal, somewhere between sixth and eighth, equal to or somewhat longer than longest dorsal spine and 2.1 (2.1-2.2) in base of fin; terminal membrane attached to peduncle under basal 0.1 or 0.2 of depressed last ray. Anal base 1.3 (1.3-1.4) in base of second dorsal; seventh or eighth ray longest, somewhat shorter than longest dorsal spine and 2.0 (1.9-2.2) in base of fin. None of the dorsal nor anal rays branched. Pectoral fin extending about to vertical of anal origin; tenth or eleventh ray longest; base of fin broad, 2.0 (1.8-2.1) in longest ray. Pelvic base midway between snout and second or third anal ray; fin extending 0.2 or 0.3 of the distance to anal origin, its length 2.0 (1.8-2.3) in width of pectoral base. Length of caudal about 1.2 in anal base.

Measurements in per mille of standard length, based on four specimens 75.1 to 146.0 mm. (average 111.5 mm.) in standard length: distance from first dorsal to pelvic 219 (196-261); distance from second dorsal to anal 153 (137-167); depth of caudal peduncle 61 (54-67); width at pectoral base 168 (162-176); length of head 405 (392-414); length of maxillary 175 (165-184); length of snout 112 (110-117); diameter of orbit 111 (99-122); distance from snout to first dorsal 329 (316-340); length of first dorsal 234 (222-247); height of first dorsal 137 (120-157); distance from snout to second dorsal 558 (541-573); length of second dorsal 331 (324-341); height of second dorsal 156 (154-158); distance from snout to anal 538 (530-544); length of anal 252 (249-257); height of anal 122 (112-129); distance from snout to pectoral 356 (349-364); width of pectoral base 123 (117-132); length of longest pectoral ray 240 (231-253); distance from snout to pelvic 285 (278-288); length of pelvic 62 (57-66); length of caudal 208 (207-210).

Fin and scale formulae: D. X—16(16-17); A. 13(13-14); P. 17; V. I,2; C. 9; Ll. 38(37-39)+1.

Color, according to Gilbert, as in *Icelinus tenuis*, but with the light spots on upper part of body not elongate and not dark margined. No conspicuous bar below orbit. Anal fin translucent. Alcoholic specimens are almost uniform light brown,

with faint indications of darker cross bars on back and irregular barring on dorsal and pectoral fins.

I have examined specimens of this species from off Florence, Oregon, Lat. 43° 58' 00" N., Long. 124° 36' 00" W.; southern California; off Ocean Beach, Lat. 32° 44' 30" N., Long. 117° 23' 00" W. (holotype); off San Diego. These four individuals are the only representatives of the species whose capture has been so far reported. They were taken on soft bottoms in depths between 93 and 124 fathoms.

Subgenus ICELINUS Jordan

ICELINUS Jordan, 1885, p. 110 (genotype by monotypy *Artedius quadriseriatus* Lockington).

A single series of scales on each side of dorsal surface of caudal peduncle; no scales behind axilla. Genital papilla not markedly enlarged in males.

First dorsal spines of moderate length, not produced and filamentous.

ICELINUS (ICELINUS) QUADRISERIATUS (Lockington)

(Fig. 13)

ARTEDIUS QUADRISERIATUS Lockington, 1880a, p. 330 (San Francisco, California); Jordan, 1887, p. 612.
ICELUS QUADRISERIATUS Jordan and Gilbert, 1882b, p. 691.
ICELINUS QUADRISERIATUS Jordan, 1885, p. 110; H. M. Smith, 1895, p. 288; Jordan, 1896, p. 225, pl. 29; Gilbert, 1895, p. 468; Jordan and Evermann, 1898a, p. 1897; Gilbert, 1899, p. 26; Starks and Morris, 1907, p. 219; Snyder, 1913, p. 458; Gilbert, 1915, p. 339; Fowler, 1923a, pp. 291, 299; Ulrey and Greeley, 1928, p. 12; Bolin, 1936, p. 158; H. W. Clark, 1936, p. 396.

Body moderately heavy, neither compressed nor depressed, subcircular in cross section throughout, width at pectoral base 1.0 (1.0-1.2) in distance from dorsal origin to pelvic base. Caudal peduncle slender, 1.8 (1.6-2.1) in orbit.

Head rather small, its length 2.9 (2.7-3.2) in standard length. Mouth small; maxillary extending to a vertical somewhere under pupil, its length 2.6 (2.3-3.1) in head. Snout steep and moderately long, its length 1.2 (1.0-1.4) in orbit. Nasal spines not strongly erect, about in line with profile of snout. Eye moderate in size; orbit 3.2 (2.8-3.6) in head. Top of head gently concave between the low, rounded, fronto-parietal ridges which terminate in short sharp spines. No spines near orbit nor on posttemporal. Upper preopercular spine 1.2 (1.0-1.5) in orbit, with two to five barbs on upper margin. A sharp spine at lower angle of subopercle. Opercular flap extending about 0.6 of an orbital diameter behind upper end of gill opening. Anterior pores of mandibular latero-sensory canal usually opening in a median pit, rarely opening separately on either side of symphysis.

Double part of dorsal scale band 20 (16-23) scales in length, extending from fourth or fifth dorsal spine to somewhere between twelfth and last dorsal ray, separated from a single series of from one to six scales on caudal peduncle by a naked interspace which may be as long as diameter of orbit or short and inconspicuous. A well-developed cirrus on maxillary. Usually a small cirrus on eyeball. Postorbital cirrus ribbon shaped, sometimes slightly fringed, its tip tapered, not expanded, its length about equal to width of maxillary. A slender cirrus midway on

fronto-parietal ridge, none at its posterior end. A similar cirrus on suborbital stay. One or two cirri on base of opercular flap. Up to twelve of the lateral-line scale margins with a single or double cirrus, these often few in number, rarely entirely absent.

Origin of first dorsal directly over or slightly behind upper end of gill opening; base of fin 1.6 (1.4-1.9) in base of second dorsal; fin with a marked anterior angle, broadly rounded posteriorly, main distal profile forming a slightly descending line which may be convex, straight, or even slightly concave; longest spine, somewhere between first and fifth, 1.3 (1.0-1.7) in base of fin. Second dorsal separated from first dorsal by an interspace about equal to width of maxillary; its origin on a vertical somewhere between anus and anal origin; longest ray, somewhere between third and seventh, about equal to or somewhat longer than longest dorsal spine and 1.9 (1.6-2.5) in base of fin; terminal membrane attached to peduncle under basal 0.1 to 0.3 of depressed last ray; rarely one or more of the middle rays may be branched. Anal origin under first to third dorsal ray, its posterior end under second or third ray from end of second dorsal; base of fin 1.2 (1.0-1.5) in base of second dorsal; longest ray, somewhere between fourth and ninth, about equal to or shorter than longest dorsal spine and 2.2 (1.9-2.7) in base of fin; none of the rays branched; last ray attached to peduncle at extreme base only. Base of upper pectoral ray under third or fourth dorsal spine; fin extending to a vertical somewhere between first and fourth anal ray; longest ray somewhere between fifth and eighth. Base of fin 2.4 (2.1-2.8) in longest ray; fin bluntly rounded, the longest ray not abruptly longer than those directly above; lower membranes rather deeply incised. Pelvic base about midway between tip of snout and first anal ray; fin extending 0.4 or 0.5 of the distance to anal origin; its length 1.1 (0.8-1.4) times width of pectoral base. Length of caudal 1.2 (1.0-1.4) in anal base.

Measurements in per mille of standard length, based on 50 specimens 51.8 to 73.4 mm. (average 65.0 mm.) in standard length: distance from first dorsal to the pelvic 195 (173-223); distance from second dorsal to anal 158 (137-173); depth of caudal peduncle 60 (53-68); width at pectoral base 189 (164-208); length of head 343 (314-373); length of maxillary 132 (108-149); length of snout 90 (79-100); diameter of orbit 107 (96-121); distance from snout to first dorsal 305 (283-329); length of first dorsal 192 (166-219); height of first dorsal 146 (117-179); distance from snout to second dorsal 521 (497-550); length of second dorsal 308 (272-344); height of second dorsal 164 (125-184); distance from snout to anal 528 (495-556); length of anal 254 (220-293); height of anal 116 (95-154); distance from snout to pectoral 320 (300-340); width of pectoral base 112 (100-125); length of longest pectoral ray 272 (247-300); distance from snout to pelvic 265 (238-312); length of pelvic 123 (95-142); length of caudal 219 (199-238).

Fin and scale formulae: D. IX(VII-X)—14(13-15); A. 12(11-13); P. 16(15-17); V. I,2; C. 9; Ll. 36(34-37)+1.

General ground color pale olive green; back crossed by three broad blackish bars, and a spot of similar color at base of caudal. The ground color is marked with numerous brownish vermiculations which, on sides of head, tend to form lines radiating from eye. A broad dark bar, bordered with whitish, extending down from suborbital stay to lower angle of subopercle. Upper lip with wide vertical bars of brown separated by narrow bands of dirty white; lower lip white at symphysis, brown on each side. Gill membranes of females with a diffuse spot of grayish yellow under chin and a black spot adjacent to opercle. In males the chin is deep orange yellow, the branchiostegal membranes black. Dorsal fins barred with brown, the first one with a black spot between tips of anterior rays and a black margin posteriorly. Distal part of caudal barred with black. Pectorals barred with black on distal part

of upper rays; a broad brown bar on its basal portion. Pelvics and anal colorless in females, blackish in males.

I have examined specimens of this species from the following localities in California: off Point Reyes, Lat. 38° 01' 30" N., Long. 123° 06' 00" W.; Lat. 37° 54' 30" N., Long. 123° 09' 15" W.; Lat. 37° 57' 30" N., Long. 123° 04' 30" W.; Lat. 37° 59' 00" N., Long. 123° 02' 00" W.; Lat. 37° 57' 30" N., Long. 122° 59' 30" W.; Lat. 37° 53' 30" N., Long. 122° 56' 30" W.; off Bolinas Point, Lat. 37° 50' 30" N., Long. 122° 51' 00" W.; San Francisco (two syntypes); off Point Santa Cruz, Lat. 36° 51' 00" N., Long. 122° 05' 00" W.; Monterey Bay, Lat. 36° 55' 30" N., Long. 122° 00' 30" W.; Lat. 36° 55' 00" N., Long. 122° 00' 00" W.; Lat. 36° 54' 30" N., Long. 121° 58' 30" W.; Lat. 36° 53' 00" N., Long. 121° 54' 30" W.; Lat. 36° 48' 15" N., Long. 121° 48' 45" W.; Lat. 36° 48' 00" N., Long. 121° 49' 30" W.; Lat. 36° 46' 45" N., Long. 121° 51' 45" W.; Lat. 36° 46' 00" N., Long. 121° 50' 00" W.; Lat. 36° 41' 00" N., Long. 121° 52' 30" W.; Lat. 36° 40' 00" N., Long. 121° 51' 00" W.; Lat. 36° 39' 15" N., Long. 121° 51' 45" W.; Lat. 36° 39' 30" N., Long. 121° 51' 45" W.; Lat. 36° 38' 30" N., Long. 121° 53' 30" W.; Lat. 36° 44' 15" N., Long. 121° 57' 00" W.; off San Miguel Island, Lat. 34° 00' 00" N., Long. 120° 23' 00" W.; off Santa Barbara, Lat. 34° 23' 10" N., Long. 119° 39' 40" W.; Lat. 34° 20' 30" N., Long. 119° 37' 50" W.; Lat. 34° 23' 00" N., Long. 119° 37' 15" W.; four miles off Hueneme; off San Pedro; off Santa Catalina Island, Lat. 33° 17' 00" N., Long. 118° 24' 00" W.; off Point Loma, Lat. 32° 34' 30" N., Long. 117° 18' 15" W.; Lat. 32° 34' 00" N., Long. 117° 14' 00" W.; and from two localities in Lower California: off San Martin Island; off Cerros Island, Lat. 28° 12' 00" N., Long. 115° 09' 00" W. The known range of this species is from off Point Reyes, California, to Cape San Lucas, Lower California. It is a very common form on sandy bottoms in depths of from ten to 55 fathoms.

Genus RADULINUS Gilbert

RADULINUS Gilbert, 1891, p. 88 (genotype by original designation *Radulinus asprellus* Gilbert).

Body very slender throughout, slightly depressed, even the caudal peduncle somewhat wider than deep.

Head short; mouth small; lower jaw shorter than upper, slightly included. A narrow band of teeth on vomer, none on palatines. Snout moderately steep. Nasal spines well developed, in line with profile of snout or slightly more erect. Anterior nostrils in short tubes with posterior margins somewhat elevated. Orbits are markedly longer than high; upper orbital margin not elevated. Interorbital space very narrow, its width equal to about 0.5 of posterior width of maxillary. Occipital region flat or very slightly concave; top of head without pronounced ridges or spines. Preopercular spines short and simple. Opercular flap ending in a rounded point. Gill membranes broadly united, free from isthmus. Gills $3\frac{1}{2}$.

Lateral line practically straight, extending well above middle of body and approaching axis only on caudal peduncle; armed with very large and strongly ctenoid scales. Small ctenoid scales on anterior part of the snout, at base of nasal spines, immediately in front of orbits, and on base of opercular flap. A patch of similar scales occupies the posterior end of the interorbital space and the upper half of the posterior orbital margin. From the lateral limit of this patch a thin band of scales extends backward and continues immediately above the lateral line to about the vertical of the middle of the second dorsal. Genital papilla of male developed into a long, slender, evenly tapered, conical penis.

Origin of first dorsal directly over or very slightly in front of tip of opercular flap; first two spines with approximate bases. Distal margin of second dorsal gently and evenly rounded, with a poorly developed angle anteriorly, ending in a blunt point posteriorly. Anal similar in shape to second dorsal but somewhat lower. Last ray of the second dorsal and anal attached to peduncle by membrane at extreme base only. Base of upper pectoral ray about under origin of first dorsal; fin extending to a vertical somewhere between first and fourth anal ray. Pectoral base moderately procurrent; fin bluntly pointed; fifth or sixth ray longest; lower membranes moderately incised. Pelvic fins I,3; outer ray shortest, inner ray the longest, not adnate to belly. Caudal slightly rounded, rather small. No branched rays in any of the fins except the caudal.

This genus contains two known species, both of them found in California.

KEY TO THE SPECIES

1a. Snout longer than eye, its length 1.4 (1.2-1.5) times diameter of orbit; nasal spines rather short, triangular; pelvic fins short, their length 1.1 (1.0-1.2) times width of pectoral base....(p. 38) R. BOLEOIDES.

1b. Snout equal to or shorter than eye, its length 1.2 (1.0-1.4) in orbit; nasal spines very long, needle like; pelvic fins long, their length 1.9 (1.7-2.6) times width of pectoral base.....(p. 40) R. ASPRELLUS.

RADULINUS BOLEOIDES Gilbert

(Fig. 14)

RADULINUS BOLEOIDES Gilbert in Jordan and Evermann, 1898a, p. 1919 (Albatross station 3664, off Avalon, Santa Catalina Island); Gilbert, 1899, p. 26, pl. 1; Starks, 1911, p. 186.

Distance from dorsal origin to pelvic base 1.2 (1.1-1.2) in width at pectoral base. Caudal peduncle 2.1 (1.8-2.2) in orbit.

Head small, 3.9 (3.7-4.3) in standard length. The maxillary extending to a vertical somewhere between anterior rim of orbit and anterior margin of pupil, its length 2.6 (2.5-2.6) in head. Snout definitely longer than eye, its length 1.4 (1.2-1.5) times diameter of orbit. Nasal spines comparatively heavy, triangular, short, the distance from tip of spine to base of tube of anterior nostril much less than depth of caudal peduncle. Posterior nostrils in very short tubes with strongly constricted tips. Eye comparatively small, orbit 3.7 (3.6-3.9) in head. The upper preopercular spine short, acutely triangular; second spine broadly triangular, becoming very blunt in old specimens; the two lower spines of related forms represented by very low, broadly rounded and definitely nonspinous expansions of the preopercular border. Opercular flap extending about 0.7 of an orbital diameter behind upper end of gill opening. A small slit behind last gill.

Scales in front of eye forming a narrow but dense band, continuous across the anterior end of the interorbital space; ventrally the band turns posteriorly and extends under each orbit in a thin and often interrupted line of scattered scales. These approach or merge with a small squamous patch just above and anterior to the upper preopercular spine. Sometimes the interorbital space is completely scaled, but usually a naked area occurs directly over pupils. Scale bands on top of head connected by an irregular transverse band of scales extending along the

occipital margin. About 15 or 20 similar scales in the region covered by the pectoral fin. From five to nine of these scales form a vertical series in the axilla proper, the remainder extend posteriorly below the lateral line almost to the tip of the pectoral. Ctenoid margin of each lateral-line scale strongly curved, its upper end approaching spines of preceding scale; central spines of these scales not conspicuously enlarged. Usually a small cirrus on upper posterior part of eyeball; a cirrus on each side of occipital border, these small, inconspicuous, often very difficult to detect among the scales. Anus about 0.7 of an orbital diameter in advance of anal origin. Length of penis about twice diameter of orbit in large adults.

Base of first dorsal 2.7 (2.7-2.8) in base of second dorsal; first spine abruptly shorter than second; fin high, with a sharply rounded contour; fourth or fifth spine longest, 1.2 (1.0-1.4) times base of fin. Second dorsal separated from first dorsal by a narrow interspace which is equal to or shorter than diameter of pupil; origin of fin over first or second anal ray, its last ray over second or third ray from end of anal; base of fin about 1.1 in anal base. Fin slightly higher posteriorly than anteriorly; longest ray, somewhere between thirteenth and seventeenth, markedly shorter than longest dorsal spine and 3.3 (2.8-4.1) in base of fin. Anal origin midway between tip of snout and eighteenth or nineteenth anal ray; longest ray, somewhere between fifteenth and twenty-first, markedly shorter than longest dorsal ray and 5.0 (4.5-5.6) in base of fin. The pectoral base moderately broad, its width 2.4 (2.2-2.5) in longest ray. Pelvic base midway between snout and a point somewhere between first and fifth anal ray; fin rather short, extending about 0.5 of the distance to second or third anal ray; length of fin 1.1 (1.0-1.2) times width of pectoral base. Length of caudal 2.9 (2.7-3.2) in anal base.

Measurements in per mille of standard length, based on three specimens 111.7 to 119.0 mm. (average 115.1 mm.) in standard length: distance from first dorsal to pelvic 132 (127-136); distance from second dorsal to anal 106 (101-110); depth of caudal peduncle 31 (24-37); width at pectoral base 150 (148-152); length of head 259 (235-271); length of the maxillary 101 (89-108); length of snout 95 (81-105); diameter of orbit 69 (65-72); distance from snout to first dorsal 249 (231-263); length of first dorsal 161 (158-166); height of first dorsal 186 (158-219); distance from snout to second dorsal 432 (419-439); length of second dorsal 443 (426-471); height of second dorsal 137 (115-155); distance from snout to anal 423 (414-430); length of anal 483 (460-512); height of anal 97 (91-103); distance from snout to pectoral 264 (236-287); width of pectoral base 94 (85-100); length of longest pectoral ray 222 (209-240); distance from snout to pelvic 230 (208-257); length of pelvic 107 (103-112); length of caudal 166 (158-172).

Fin and scale formulae: D. X—21; A. 22(22-23); P. 20(19-20); V. I,3; C. 9(8-9); Ll. 40(39-40).

Dorsal ground color olive gray; back crossed by four wide brownish cross bars, their margins marked by concave indentations; small dark blotches along the middle of sides. Branchiostegal membranes and belly silvery; other ventral surfaces translucent white. Dorsals, caudal, and upper part of pectoral fins faintly barred with brownish; pelvics and anal colorless.

I have examined specimens of this species from the San Juan Islands, Washington, and from Monterey Bay, California, Lat. 36° 49' 00" N., Long. 121° 58' 45" W. The known range is from the San Juan Islands to Santa Catalina Island, in depths of from 65 to 80 fathoms. It is nowhere common and has apparently been taken only twice in California.

RADULINUS ASPRELLUS Gilbert

(Fig. 15)

RADULINUS ASPRELLUS Gilbert, 1891, p. 88 (Albatross stations 3046, 3057, 3058, and 3059, off the coasts of southern Washington and northern Oregon); 1895, p. 469; Jordan and Evermann, 1898a, p. 1920; 1900, fig. 696; Gilbert, 1915, p. 341; Schultz and DeLacy, 1936b, p. 127; Hubbs and Schultz, 1941, p. 8.

Distance from dorsal origin to pelvic base 1.1 (0.9-1.2) in width at pectoral base. Caudal peduncle 2.9 (2.3-3.6) in orbit.

Head small, 4.1 (3.8-4.4) in standard length. Maxillary extending about to vertical of anterior margin of pupil, its length 2.6 (2.3-2.8) in head. The snout comparatively short, its length 1.2 (1.0-1.4) in orbit. Nasal spine long, slender, needle like, the distance from tip of spine to base of tube of anterior nostril is equal to or greater than depth of caudal peduncle. Posterior nostril transversely elongated, without raised margins, appearing like adjacent pores of supraorbital latero-sensory canal. Eye comparatively large, diameter of orbit 2.8 (2.5-3.1) in length of head. Upper preopercular spine well developed, needle like; second spine triangular but with a sharp point; the two lower spines with acute tips in young specimens only, broadly and evenly rounded and nonspinous in adults. Opercular flap extending about 0.5 of an orbital diameter behind upper end of gill opening. No slit behind last gill.

A very few scales on anterior orbital margin; often a few scales in anterior part of interorbital space, but these always widely spaced and never forming a compact transverse band; often a few small scales below orbit, these usually present only posteriorly; usually one or more scales above and anterior to base of upper preopercular spine, but scales often entirely absent in this area. Interorbital space almost entirely naked; sometimes a poorly developed transverse band of scales along occipital margin, this composed of widely scattered scales and only rarely complete, usually entirely absent or represented by a single scale on each side. Usually from one to four scales in or slightly above axilla, rarely these are entirely absent. Ctenoid margins of lateral-line scales very slightly curved, and practically parallel throughout; one to three of the central spines conspicuously enlarged. No cirrus on eyeball. Rarely a long but very slender and inconspicuous cirrus on occipital margin. Anus about 0.5 of an orbital diameter in advance of anal origin. Length of penis about 1.2 times diameter of orbit in large adults.

Base of first dorsal 3.1 (2.7-3.4) in base of second dorsal; the first two dorsal spines usually abruptly shorter than third, forming a slight notch in anterior profile of fin, but occasionally the first three spines evenly graduated; posteriorly the fin contour is bluntly rounded; longest spine, somewhere between fourth and sixth, 1.3 (1.1-1.6) in base of fin. Second dorsal usually separated from first dorsal by a narrow interspace, sometimes contiguous to it, or even with membrane from last spine attached to basal portion of first ray; origin of fin about over anal origin, last ray over second or third ray from end of anal; base of fin 1.1 (1.0-1.1) in anal base; fin slightly higher anteriorly than posteriorly; longest ray, somewhere between fourth and eighth, about equal to longest dorsal spine and 3.9 (3.4-4.6) in base of fin. Anal origin midway between tip of snout and a point somewhere between seventeenth and twentieth anal ray; longest ray, somewhere between fourth and twenty-third, markedly shorter than longest dorsal spine and 5.3 (4.4-6.4) in base of fin. Pectoral base rather narrow, its width 2.8 (2.5-3.2) in longest ray. Pelvic base midway between snout and a point somewhere

between base of genital papilla and fourth anal ray; fin rather short in females, reaching to or almost to anus; longer in males, extending slightly beyond anus or even to anal origin; length of fin 1.9 (1.7-2.6) times width of pectoral base. Length of caudal 2.8 (2.4-3.3) in anal base.

Measurements in per mille of standard length, based on 50 specimens 69.7 to 110.3 mm. (average 91.5 mm.) in standard length: distance from first dorsal to pelvic 127 (102-152); distance from second dorsal to anal 99 (85-111); depth of caudal peduncle 30 (26-35); width at pectoral base 137 (118-154); length of head 246 (227-265); length of maxillary 96 (85-111); length of snout 74 (60-90); diameter of orbit 87 (76-100); distance from snout to first dorsal 239 (222-260); the length of first dorsal 153 (140-169); height of first dorsal 120 (99-151); distance from snout to second dorsal 420 (401-441); length of second dorsal 463 (439-500); height of second dorsal 122 (103-135); distance from snout to anal 419 (392-451); length of anal 490 (452-516); height of anal 92 (80-109); distance from snout to pectoral 242 (216-265); width of pectoral base 80 (68-90); length of longest pectoral ray 219 (196-252); distance from snout to pelvic 225 (195-269); length of the pelvic 170 (149-183) in males, and 150 (128-172) in females; length of caudal 176 (150-205).

Fin and scale formulae: D. X(IX-XI)—22(21-23); A. 23(22-25); P. 18(17-20); V. I,3; C. 9(7-10); Ll. 39(38-40).

Dorsal surfaces olive green marbled with pale orange brown; back with three or four indistinct cross bars of slightly darker color; diffuse blackish spots along lateral line. Branchiostegal membranes and belly creamy white, other ventral surfaces translucent gray. Dorsal, caudal and upper part of pectorals barred with reddish brown; lower part of pectorals, pelvics, and margin of anal creamy white; a small blackish spot at posterior end of first dorsal in males.

I have examined specimens of this species from Puget Sound, Washington; from off Tillamook Head, Oregon, Lat. 46° 03' 15" N., Long. 124° 09' 00" W.; and from the following localities in California: off Fort Bragg, Lat. 39° 35' 00" N., Long. 123° 56' 00" W.; Lat. 39° 27' 30" N., Long. 123° 54' 30" W.; off Fort Ross, Lat. 38° 23' 35" N., Long. 123° 14' 00" W.; Monterey Bay, Lat. 36° 47' 15" N., Long. 121° 51' 00" W.; Lat. 36° 44' 20" N., Long. 121° 56' 50" W.; Lat. 36° 44' 00" N., Long. 121° 58' 00" W.; Lat. 36° 43' 45" N., Long. 121° 58' 00" W.; Lat. 36° 42' 30" N., Long. 121° 55' 00" W.; Lat. 36° 39' 30" N., Long. 121° 52' 00" W.; off Point Estero, Lat. 35° 23' 30" N., Long. 121° 02' 30" W.; off Point San Luis, Lat. 35° 06' 00" N., Long. 120° 51' 00" W.; off Gaviota, Lat. 34° 26' 00" N., Long. 120° 14' 00" W. The known range of the species is from Kodiak Island, Alaska, to the Coronados Islands, Lower California. It is a rather common species on soft bottoms in depths ranging from 26 to 92 fathoms.

Genus ARTEDIUS Girard

ARTEDIUS Girard, 1856, p. 134 (genotype by subsequent designation of Jordan and Evermann, 1896, *Scorpaenichthys lateralis* Girard).

Body heavy and robust, particularly anteriorly, somewhat compressed posteriorly, tapering in an even and gentle curve from the deepest point under first dorsal to the caudal peduncle.

Head broad and depressed. Lower jaw somewhat shorter than upper, slightly included. Teeth in well-developed bands on both vomer and palatines. The anterior nostril in a well-developed tube, its posterior margin elevated to form a valvular

flap. Eye somewhat longer than high. Upper preopercular spine short, simple to multifid, never long and antler like. Opercular flap ending in a rounded point, extending from 0.4 to 0.8 of an orbital diameter behind upper end of gill opening. Gill membranes broadly united, free from isthmus. Gills $3\frac{1}{2}$.

Lateral line descending in a straight or very slightly curved line from the upper border of the supracleithrum to approach the body axis at about vertical of pectoral tip. A prominent band of ctenoid scales extending along each side of body; at its extreme anterior end this band of scales is near or in contact with the lateral line, posteriorly it diverges from the lateral line and approaches the second dorsal; the scales arranged in diagonal rows of various lengths, there being at least three scales in the longest row. A number of cirri on the head and body; always one or more on posterior part of maxillary; a well-developed postorbital cirrus at upper posterior margin of orbit; one or more cirri on base of opercular flap and several on scale margins of the lateral line, most of the latter concentrated anteriorly. Anus not notably advanced in position.

Origin of first dorsal a little in advance of upper end of gill opening; first two spines with approximate bases; fin with a marked anterior angle, bluntly rounded posteriorly. Second dorsal gently rounded anteriorly, more abruptly rounded posteriorly; longest ray markedly longer than longest dorsal spine. Anal origin directly under or somewhat behind origin of second dorsal, its posterior end in advance of end of second dorsal; fin similar in shape to second dorsal but somewhat lower and with membranes moderately incised. Pectoral base broad, strongly procurrent; lower membranes rather deeply incised. Pelvics I,3; the inner ray not adnate to belly. Caudal fin slightly rounded. No branched rays in any of the fins except caudal.

This genus contains about nine species, seven of which occur in California.

KEY TO THE CALIFORNIA SPECIES

1a. Conspicuous ctenoid scales on top of head.
 2a. A well-developed cirrus on upper anterior margin of orbit; dorsal scale band more or less merging with squamation of head.
  3a. Second dorsal with 12-14 rays; anal with 10 rays; scales extending under entire orbit, and present even on snout.....(p. 43) A. CREASERI.
  3b. Second dorsal with 16-18 rays; anal with 12-14 rays; scales extending only under posterior part of orbit, if at all; no scales on snout.....(p. 45) A. HARRINGTONI.
 2b. No preorbital cirrus; dorsal scale band originating about under base of third dorsal spine, separated from scales of head by a naked area or preceded by scales so minute and scattered that they do not obscure the definite origin of the band.
  4a. Dorsal scale bands continued on dorsal surface of caudal peduncle where they form a dense patch of scales; scales extending under entire orbit; second dorsal with 16-18 rays; anal with 12-14 rays; pectoral with 14-16 rays.....(p. 48) A. FENESTRALIS.
  4b. Dorsal scale band extending to end of second dorsal, sometimes continued on dorsal surface of caudal peduncle by a few widely scattered scales, but these never forming a dense patch; scales extending only under posterior part of orbit, if at all; second dorsal with 15-16 rays; anal with 11-12 rays; pectoral with 16-17 rays.....(p. 50) A. NOTOSPILOTUS.

1b. No scales on head.
5a. Dorsal scale band with 39-49 oblique rows of scales and 10-18 scales in the longest row; a few small scales just behind opercular flap between pectoral base and lateral line....(p. 53) A. CORALLINUS.
5b. Dorsal scale band with 18-29 oblique rows of scales and 3-11 scales in longest row; no scales behind opercular flap.
6a. Dorsal scale band with 24-29 rows of scales and 6-11 scales in longest row; preopercular spine usually bifid, rarely simple or trifid.....(p. 55) A. LATERALIS.
6b. Dorsal scale band with 18-22 rows of scales and 3-4 scales in longest row; preopercular spine multifid.....(p. 57) A. HANKINSONI.

Subgenus RUSCARIOPS Hubbs

RUSCARIOPS Hubbs, 1926a, p. 12 (genotype by original designation *Ruscariops creaseri* Hubbs).

Posterior nostril not tubular, its margins only slightly elevated. All four preopercular spines distinctly developed, the three lower ones sharply pointed. A small pore behind last gill.

Top of head above level of suborbital stay and upper preopercular spine densely covered with small ctenoid scales. Dorsal scale band continuous with scales on head; very broad, covering entire space between lateral line and first dorsal anteriorly; diverging gradually from lateral line and in contact with second dorsal posteriorly, a small scale at base of each dorsal ray, except the last one or two, forming the upper scale of the diagonal series; band continued on dorsal surface of caudal peduncle. A well-developed preorbital cirrus on upper anterior margin of orbit. Genital papilla of males not enlarged.

ARTEDIUS (RUSCARIOPS) CREASERI (Hubbs)

(Fig. 16)

RUSCARIOPS CREASERI Hubbs, 1926a, p. 12 (Bird Rock, San Diego County, California; paratypes from White Point, Los Angeles County, and Point Lobos, Monterey County).

Body short, subcircular or slightly compressed anteriorly; distance from dorsal origin to pelvic base 1.0 (0.9-1.0) in width at pectoral base. Caudal peduncle rather slender, its depth 1.2 (1.1-1.3) in orbit.

Head large, about 2.5 in standard length. Mouth rather large; maxillary extending to a vertical somewhere between middle of pupil and posterior margin of orbit, its length 2.1 (2.0-2.2) in head. Teeth small and of uniform size. Snout not steep, forming a somewhat depressed but not markedly distinct continuation of occipital profile, rather short, its length 1.0 (1.0-1.1) times diameter of orbit. Nasal spines small, sharp, not extending to tip of premaxillary process, about in line with profile of snout or slightly more erect. Valve of anterior nostril very long, slightly fringed. Eye large; orbit about 3.7 in head; upper orbital margin somewhat elevated, protruding slightly above general profile of head. Interorbital space narrow, its width a little less than posterior width of maxillary, grooved. Occipital region flat or slightly concave. No spines on top of head. Upper preoper-

cular spine simple or bifid, of moderate size, curved upward; second spine directed downward and backward, third spine straight downward, lowest one downward and forward, the latter often obscured by skin.

Scales on top of head extending forward along elevated upper margin of the orbit, along entire lower edge of orbit, and even occurring on snout. Dorsal scale band of body continuous anteriorly with the somewhat smaller scales of head, extending posteriorly to slightly beyond base of upper caudal ray, the bands of the two sides approaching each other closely on the dorsal surface of the caudal peduncle, but no scales occurring on the median line. Between the origin of the first dorsal and the base of the last dorsal ray, the band contains from 26 to 29 diagonal rows of scales with from 15 to 19 scales in the longest row. As many as five small scales may occur a little behind opercular flap and between pectoral base and lateral line; these scales may be entirely lacking. Lateral-line scales with strongly ctenoid margins. A well-developed cirrus at base of nasal spine; and one single and one double or triple cirrus near posterior end of maxillary. A row of tiny cirri on eyeball, most of them merely small papillae. Preorbital cirrus long, finger like; the postorbital cirrus large, flat, very strongly fringed. A median, finger-like cirrus between the postorbital cirri, and sometimes a similar small cirrus in front of them. An ill-defined curved line of cirri extending backward from each postorbital cirrus to immediately in front of upper end of gill opening; anteriorly the cirri are single and separate, and occur mesad and laterad to, as well as on, the fronto-parietal ridges; posteriorly they become aggregated into roughly linear clusters or become branched almost to the base. A small bifid to multifid cirrus midway on suborbital stay and sometimes a smaller simple cirrus on cheek below it. Several cirri on preopercular margin, arranged in small clusters on or just above the spines, often lacking from lower spines. A well-developed tuft of cirri on base of opercular flap. Sometimes a minute cirrus immediately behind upper end of gill opening. From one to four cirri on from 13 to 18 of the lateral-line scale margins. Each of the spines of first dorsal tipped by a slender cirrus.

Base of first dorsal 1.2 (1.1-1.4) in base of second dorsal; major distal profile of fin very gently rounded, almost parallel to back; sixth spine longest, 2.0 (1.9-2.1) in base of fin. Second dorsal contiguous to first dorsal or separated from it by a very narrow interspace, its origin on a vertical between anus and anal origin; major portion of distal profile describing a gentle curve of almost uniform height throughout; longest ray, somewhere between fourth and seventh, about 1.7 in base of fin; terminal membrane attached to peduncle under basal 0.5 of depressed last ray. Origin of anal under first or second dorsal ray, its posterior end under third to fifth ray from end of second dorsal; base of fin about 1.4 in base of second dorsal; fin somewhat higher anteriorly than posteriorly; longest ray, somewhere between fourth and sixth, about equal to or a little longer than longest dorsal spine and 1.6 (1.6-1.7) in base of fin; terminal membrane attached to peduncle under basal 0.1 or 0.2 of depressed last ray. Base of upper pectoral ray about under third or fourth dorsal spine; fin extending to a vertical somewhere between second and fourth dorsal ray, bluntly rounded; eighth ray longest. Base of fin 2.0 (2.0-2.1) in longest ray. Pelvic base midway between snout and third, fourth, or fifth anal ray; fin extending about to vertical of next to last dorsal spine; its length 1.2 (1.1-1.2) times width of pectoral base; middle ray longest, inner ray shortest. Length of caudal 1.0 (0.9-1.0) in anal base.

Measurements in per mille of standard length, based on two specimens 48.5 and 50.9 mm. in standard length: distance from first dorsal to pelvic 261 (245-277); distance from second dorsal to anal 214 (204-223); depth of caudal peduncle 92 (86-98); width at pectoral base 254 (250-257); length of head 398 (394-401);

ength of maxillary 188 (181-194); length of snout 110 (107-114); diameter of orbit 08 (107-108); distance from snout to first dorsal 331 (318-344); length of first orsal 266 (254-279); height of first dorsal 135 (134-136); distance from snout to econd dorsal 597 (573-621); length of second dorsal 322 (301-344); height of the econd dorsal 188 (179-198); distance from snout to anal 586 (569-602); length of nal 230 (218-241); height of anal 142 (132-153); distance from snout to pectoral 64 (356-371); width of pectoral base 154 (151-157); length of longest pectoral ray 12 (312-313); distance from snout to pelvic 339 (324-354); length of pelvic 184 171-196); length of caudal 240 (236-245).

Fin and scale formulae: D. X(X-XI)—13(12-14); A. 10; P. 16(15-17); V. I,3; . 9; Ll. 33+1.

Ground color olive or bluish gray reticulated with pink or brown. The back rossed by five blackish-brown bars which do not merge ventrally. Sides olive or eddish brown, becoming flushed with pink over abdomen, and interrupted by streaks f bluish gray which break up into small spots posteriorly. Head olive, marked with ark brown or red. Throat bluish or olive. First dorsal of males barred with red nd orange, bordered by bluish, the extreme margin yellowish; fin barred with red nd black in female. Second dorsal and caudal barred with red and bluish gray or lack. Pectorals spotted with red. Anal and pelvics blackish in males, pale in emales, the anal faintly spotted with red.

I have examined specimens of this species from Pescadero Point, Monterey ounty, Lat. 36° 33' 42" N., Long. 121° 57' 15" W., and from Bird Rock, San Diego ounty, California. These localities represent the known limits of the range of his rare tide-pool species.

Subgenus AXYRIAS Starks

XYRIAS Starks, 1896b, p. 554 (genotype by monotypy *Axyrias harringtoni* Starks).
TERYGIOCOTTUS Bean and Weed, 1920, p. 73 (genotype by original designation *Pterygiocottus macouni* Bean and Weed = male of *Axyrias harringtoni* Starks).

Posterior nostril with a well-developed, cylindrical tube, its tip usually onstricted. Only the upper preopercular spine well developed, the second spine epresented by a very low and obtuse angular expansion of the preopercular border, he lower spines entirely undeveloped. No slit behind last gill.

Top of head above level of suborbital stay and preopercular spine covered ith irregularly but densely scattered ctenoid scales. Dorsal scale band of body ontinuous with head scales, in direct contact with lateral line and well separated rom first dorsal anteriorly, diverging abruptly from lateral line and in contact ith base of second dorsal posteriorly and continued behind the fin on the dorsal urface of caudal peduncle. A small scale at the base of each dorsal ray except the irst; posteriorly these become the upper scales of the diagonal series in the orsal scale band. A well-developed preorbital cirrus on upper anterior margin of rbit. Genital papilla of male markedly enlarged and modified to form a penis which erminates in a slender tapered tip.

ARTEDIUS (AXYRIAS) HARRINGTONI (Starks)

(Fig. 17)

XYRIAS HARRINGTONI Starks, 1896b, p. 554, pl. 74 (vicinity of Port Ludlow, Washington); Jordan and Evermann, 1898a, p. 1904; Schultz and DeLacy, 1936a, p. 78.
XYRIAS HARRINGTONII Bean and Weed, 1920, p. 72.
TERYGIOCOTTUS MACOUNI Bean and Weed, 1920, p. 73, pl. 3 (Ucluelet, British Columbia).

Body slightly elevated under first dorsal, nowhere giving the impression of being depressed; width at pectoral base 1.1 (0.9-1.3) in the distance from dorsal origin to pelvic base. Caudal peduncle comparatively heavy, its depth 1.0 (0.9-1.2) in diameter of orbit.

Head rather small, 2.8 (2.6-3.0) in standard length. Mouth of moderate size; maxillary extending to a vertical somewhere between middle of pupil and posterior margin of orbit, its length 2.3 (2.0-2.7) in head. Teeth of jaws strongly cardiform and irregular in size, some of the larger ones protruding a little above general level of the toothed surface and appearing like small canines. Snout steep, forming an abrupt angle with top of head and definitely not an even continuation of the occipital profile, rather short, its length 1.0 (0.8-1.5) times diameter of orbit. Nasal spines well developed, extending to or somewhat beyond tip of premaxillary process, about in line with profile of snout or slightly more erect. Valve of the anterior nostril rather small, finger like or rarely branched; tube of posterior nostril markedly larger than that of anterior nostril, extending to or beyond tip of nasal spine. Eye rather large; orbit 3.8 (3.3-4.7) in head. Upper orbital margin somewhat elevated, usually protruding slightly above general profile of head. The interorbital space rather narrow, its width a little greater than posterior width of maxillary, channeled by a longitudinal groove which becomes more pronounced with advancing age. Occipital region flat; no spines on top of head. Upper preopercular spine short, usually bifid, rarely trifid.

Scales on top of head extending forward for a short distance in the interorbital space and usually under the posterior end of the eye; no scales on snout. Posteriorly the head scales tend to merge with the dorsal scale bands which extend to about the base of the upper caudal ray, the bands of the two sides becoming confluent and forming a dense patch of scales on dorsal surface of caudal peduncle. Between the origin of the first dorsal and the posterior end of the second dorsal the band contains from 38 to 51 diagonal rows of scales with from nine to 16 scales in the longest row. From five to 20 similar scales behind axilla, the upper ones usually extending above level of pectoral base. Lateral-line scales slightly enlarged, deeply embedded, only their ctenoid posterior margins exposed. A small cirrus at base of nasal spine; one to three cirri near posterior end of maxillary; no cirri on eyeball. Preorbital cirrus of females well developed but simple and tapered; in males this structure becomes fringed and very much enlarged, with a pronounced basal thickening extending downward along entire anterior margin of the orbit, the free portion about as long as eye. Postorbital cirrus large, flat, and fringed; often one or two simple cirri between and slightly behind the postorbital cirri. A row of three cirri along each fronto-parietal ridge, the anterior ones usually flattened and fringed, the posterior ones usually simple. A single cirrus on side of head just below anterior fronto-parietal cirrus; usually a transverse series of three small simple cirri extending across top of head just in front of last pair of fronto-parietal cirri, one or more of these often lacking. Usually a small cirrus midway on suborbital stay and three to five cirri along preopercular margin. One to three simple cirri on base of opercular flap and usually a similar one a little above dorsal end of gill opening. Usually a small cirrus just behind opercular flap between pectoral base and lateral line. From one to three cirri on from four to 13 of the scale margins of lateral line. A small cirrus on tip of each spine of first dorsal; these difficult to see in poorly preserved specimens.

Base of first dorsal 1.7 (1.3-2.1) in base of second dorsal; major portion of distal profile very gently rounded, almost parallel to back; longest spine, somewhere between third and sixth, 1.8 (1.5-2.3) in base of fin. Second dorsal contiguous to first dorsal or with membrane from last spine definitely attached to

basal portion of the first ray; origin of fin on a vertical between anus and anal origin; major portion of distal profile almost straight and somewhat higher anteriorly than posteriorly; longest ray, somewhere between second and eighth, 2.3 (2.0-2.5) in base of fin; terminal membrane attached to peduncle under basal 0.5 or 0.6 of depressed last ray. Anal origin under first to third dorsal ray, its posterior end under third or fourth ray from end of second dorsal; base of fin 1.3 (1.1-1.4) in base of second dorsal; longest ray, somewhere between third and eleventh, is intermediate in length between longest dorsal spine and longest dorsal ray and 2.0 (1.8-2.5) in base of fin; terminal membrane attached to peduncle under basal 0.1 of depressed last ray, or entirely missing; incised membranes concave in females, convex in males. Base of upper pectoral ray about under third or fourth dorsal spine; fin extending to a vertical somewhere between third and sixth dorsal ray, bluntly pointed; sixth or seventh ray longest; base of fin 2.4 (2.1-2.9) in longest ray. Pelvic base midway between snout and third, fourth, or fifth anal ray; fin extending to a vertical somewhere between seventh dorsal spine and first dorsal ray; its length 1.2 (1.1-1.4) times width of pectoral base; middle ray, or sometimes the outer ray, longest; inner ray shortest. Caudal 1.2 (1.1-1.4) in length of anal base.

Measurements in per mille of standard length, based on 50 specimens 17.9 to 81.3 mm. (average 44.1 mm.) in standard length: distance from first dorsal to the pelvic 241 (208-290); distance from second dorsal to anal 226 (198-254); depth of caudal peduncle 89 (80-105); width at pectoral base 223 (193-255); length of head 355 (334-380); length of maxillary 154 (128-187); length of snout 97 (79-116); diameter of orbit 93 (79-108); distance from snout to first dorsal 295 (271-317); length of first dorsal 228 (195-271); height of first dorsal 123 (108-148); distance from snout to second dorsal 539 (514-568); length of second dorsal 382 (350-421); height of second dorsal 169 (154-201); distance from snout to anal 554 (517-614); length of anal 304 (267-346); height of anal 156 (130-180); distance from snout to pectoral 333 (303-371); width of pectoral base 134 (119-156); length of longest pectoral ray 327 (286-362); distance from snout to pelvic 312 (277-375); length of pelvic 167 (152-182); length of caudal 248 (215-288).

Fin and scale formulae: D. X(IX-X)—17(16-18); A. 13(12-14); P. 14(13-15); V. I,3; C. 9(7-10); Ll. 36(35-38)+1(1-2).

Ground color olive or brown; back with five dark cross bars and a streak of similar color at base of caudal; sides with many clear-cut, round, white spots, increasing in size ventrally, the lower ones incomplete, merging with white color of belly and ventral surfaces. Lips and ventral surfaces of head with wavy olive-brown bars and white spots and lines in females, uniformly dusky in males. Dorsal, caudal, and pectoral fins barred with brown; anal and pelvic white in females, dusky in males; anal of male marked by fine lines forming a lace-work of small hexagons.

I have examined specimens of this species from Nanaimo, British Columbia; from the following localities in Washington: San Juan Islands; Turn Rock, Lat. 48° 32' 08" N., Long. 122° 57' 45" W.; False Bay, San Juan Island; Puget Sound; Port Ludlow (the holotype); Port Orchard; and from Point Lobos, California, Lat. 36° 31' 10" N., Long. 121° 57' 11" W.; Lat. 36° 31' 07" N., Long. 121° 57' 14" W. The first and last of the localities listed above represent the known limits of the range of the species. In Puget Sound it is a common tide-pool and shallow-water form; in California it is rare.

Subgenus ASTROLYTES Jordan and Starks

ASTROLYTES Jordan and Starks, 1895, p. 807 (genotype by original designation *Artedius fenestralis* Jordan and Gilbert).
PARASTROLYTES Hubbs, 1926a, p. 2 (genotype by original designation *Artedius notospilotus* Girard).

Mouth large; maxillary extending to a vertical somewhere between middle of pupil and posterior margin of orbit, or even somewhat beyond orbit in large specimens. Teeth of jaws rather coarse, of approximately equal size. Snout rather steep, forming a fairly abrupt angle with top of head and definitely not an even continuation of occipital profile, often markedly convex. Nasal spines well developed, extending to or slightly beyond tip of premaxillary process, about in line with profile of snout or slightly more erect. Tube of posterior nostril markedly larger than that of anterior nostril, cylindrical or with a somewhat constricted tip. Upper orbital margins scarcely elevated in young specimens, strongly elevated in adults and protruding above general profile of head. Interorbital space rather narrow, its width equal to or a little greater than posterior width of maxillary, channeled by a longitudinal groove which becomes more pronounced with advancing age.

Top of head above level of suborbital stay and upper preopercular spine with irregularly scattered scales. Dorsal scale band of body very close to lateral line and widely separated from first dorsal anteriorly, diverging abruptly from lateral line posteriorly and approaching but not coming in contact with second dorsal; the small scales which occur at the base of several of the dorsal rays (always missing from base of first ray and a few of the posterior ones) are distinct and separated from the dorsal band by a definite but very narrow naked area. Usually a few small and scattered scales behind opercular flap between pectoral base and lateral line. Lateral-line scales moderately ctenoid but deeply embedded and inconspicuous. No cirrus on upper anterior orbital margin. One or two cirri on base of opercular flap. A number of the posterior spines of first dorsal tipped with small cirri. Genital papilla of males not enlarged.

Second dorsal contiguous to first dorsal or separated from it by a very narrow interspace; its origin directly over or very slightly behind anus. Pectoral fin bluntly rounded. Middle ray of pelvic usually the longest but sometimes equaled or even exceeded by outer ray; inner ray shortest.

ARTEDIUS (ASTROLYTES) FENESTRALIS (Jordan and Gilbert)

(Fig. 18)

ARTEDIUS NOTOSPILOTUS Jordan and Jouy, 1882, p. 6 (No. 27146); Bean, 1882a, p. 250; 1882b, p. 471 (not of Girard).
ICELUS NOTOSPILOTUS Jordan and Gilbert, 1882b, p. 690 (the "northern variety" not of Girard).
ICELUS FENESTRALIS Jordan and Gilbert, 1882b, p. 973 (no type locality given).
ARTEDIUS FENESTRALIS Jordan and Gilbert, 1883, p. 577 (Commencement Bay, Washington).
ASTROLYTES FENESTRALIS Jordan and Starks, 1895, p. 807; Jordan and Evermann, 1898a, p. 1899; Hubbs, 1926a, p. 1.
ARTEDIUS ASPERULUS Starks, 1896b, p. 553 (vicinity of Port Ludlow, Washington).
ASTROLYTES NOTOSPILOTUS Jordan and Evermann, 1900, fig. 689a (not of Girard).

Body more or less subcircular in cross section anteriorly; distance from dorsal origin to pelvic base 1.0 (0.9-1.2) in width at pectoral base. Caudal peduncle moderately slender, its depth 1.1 (0.9-1.3) in diameter of orbit.

Head rather small, 2.8 (2.6-2.9) in standard length. Length of maxillary 2.2 (1.9-2.4) in head. Snout rather long, its length 1.2 (1.0-1.4) times diameter of orbit. Nasal spines simple and sharply pointed at all ages. Valve of anterior nostril broad and fringed; tube of posterior nostril extending to or beyond tip of nasal spine. Eye moderate in size; orbit 4.2 (3.3-4.6) in head. Occipital region slightly depressed. A pair of low, blunt, recumbent spines behind upper posterior angle of orbit in large adults; these spines poorly developed in small specimens and often rather difficult to distinguish in individuals as large as 80 mm. in standard length; no other spines on top of head. Upper preopercular spine heavy, bifid to quadrifid, the upper points usually recurved; second spine sharply pointed in young specimens, becoming broad and rounded in old ones; lower two spines obsolete, represented by very broad and indistinct expansions of the preopercular border. A small pore behind the last gill.

Scales of head usually extending forward in interorbital space, scattered scales sometimes occurring as far forward as vertical of anterior orbital margin; a narrow band of scales along the entire ventral margin of orbit; posteriorly the scales of the head become minute and widely scattered, and although they may extend to the anterior end of the dorsal scale band they do not, due to their small size, obscure the sharp origin of this band. A dorsal scale band extending from about the vertical of third dorsal spine to well beyond end of the second dorsal, the scales of the two sides confluent and forming a dense patch on upper surface of caudal peduncle. Between its origin and base of last dorsal ray the band contains from 26 to 29 diagonal rows of scales with from nine to eleven scales in the longest row. Most specimens have a number of small, inconspicuous, irregularly scattered scales between the definite scale band and the first dorsal fin. In some specimens they almost cover the entire area, in others they are few in number or they may even be entirely lacking. Usually from one to nine small scales scattered behind opercular flap between pectoral base and lateral line. No cirri immediately above upper lip, nor on nasal spines, nor on eyeball. A single cirrus near posterior end of maxillary. One or two finger-like postorbital cirri. Usually three cirri between the postorbital ones; these arranged in the form of a broad-based triangle with the apex directed anteriorly; any of them may be double or missing. One to four cirri surmounting or directly behind each postorbital spine; a small cirrus midway on fronto-parietal ridge and one near its posterior end. Usually a single cirrus somewhat laterad to each of the anterior fronto-parietal cirri and another on the midline between them; usually a transverse line of three cirri between posterior ends of fronto-parietal ridges. No cirri on the suborbital stay. Usually one to three minute cirri on preopercular border. One to three simple cirri on from one to twelve of the scale margins of the lateral line. A few of the posterior spines of the first dorsal tipped by small cirri.

Base of first dorsal 1.6 (1.5-2.0) in base of second dorsal; major portion of distal profile straight or very gently rounded, almost parallel to back; longest spine, somewhere between second and sixth, 2.0 (1.3-2.3) in base of fin. Distal profile of second dorsal almost straight and somewhat higher anteriorly than posteriorly; longest ray, somewhere between fourth and tenth, 2.4 (2.2-2.6) in base of fin; terminal membrane attached to peduncle under basal 0.2 to 0.5 of depressed last ray. Origin of anal under second or third dorsal ray, its posterior end under second to fourth ray from end of second dorsal; base of fin 1.3 (1.2-1.4) in base of second dorsal; fin of about uniform height throughout; longest ray, somewhere

between seventh and eleventh, intermediate in length between longest dorsal spine and longest dorsal ray and 2.0 (1.8-2.3) in base of fin; terminal membrane attached to peduncle under basal 0.1 or 0.2 of depressed last ray. Base of upper pectoral ray under second or third dorsal spine; fin extending to a vertical somewhere between the second and fifth dorsal ray; seventh or eighth ray longest; base of fin 2.2 (1.9-2.7) in longest ray. Pelvic base midway between snout and a point somewhere between first and fourth anal ray; fin sometimes reaching anus, extending to a vertical somewhere between last dorsal spine and first dorsal ray; its length 1.4 (1.2-1.9) times width of pectoral base. Length of caudal 1.2 (1.1-1.4) in anal base.

Measurements in per mille of standard length, based on 22 specimens 51.3 to 103.0 mm. (average 80.3 mm.) in standard length: distance from first dorsal to pelvic 231 (202-264); distance from second dorsal to anal 202 (183-233); depth of caudal peduncle 77 (70-85); width at pectoral base 231 (205-253); length of head 362 (343-388); length of maxillary 162 (148-194); length of snout 106 (92-123); diameter of orbit 86 (80-98); distance from snout to first dorsal 302 (281-322); length of first dorsal 220 (187-252); height of first dorsal 112 (90-160); distance from snout to second dorsal 538 (520-564); length of second dorsal 367 (345-402); height of second dorsal 158 (144-167); distance from snout to anal 545 (514-611); length of anal 276 (257-300); height of anal 138 (124-146); distance from snout to pectoral 335 (315-359); width of pectoral base 134 (126-146); length of longest pectoral ray 302 (242-341); distance from snout to pelvic 315 (277-372); length of pelvic 186 (161-205); length of caudal 226 (199-249).

Fin and scale formulae: D. IX(VIII-IX)—17(16-18); A. 13(12-14); P. 15(15-16); V. I,3; C. 9; Ll. 37(36-37)+1(1-2).

Ground color olive brown; back crossed by five irregular dark bars and a streak of similar color at base of caudal; sides with numerous round white spots, the lower ones incomplete and merging with white color of belly and ventral surfaces. Lips dusky. Dorsal, caudal, and pectoral fins barred with brown; pelvics and anal colorless.

I have examined specimens of this species from Karta Bay, Prince of Wales Island, Alaska; from the following localities in Washington: San Juan Islands; Puget Sound; Port Angeles; Port Orchard; and from Humboldt Bay, California, Lat. 40° 49' 08" N., Long. 124° 10' 44" W. Its recorded range is from Unalaska, Alaska, to San Francisco Bay, California. The species is a common shallow-water form in the Puget Sound area, but it is rare in California. It has been taken in tide pools on a few occasions.

ARTEDIUS (ASTROLYTES) NOTOSPILOTUS Girard

(Fig. 19)

CALYCILEPIDOTUS LATERALIS Ayres, 1855, p. 77 (not of Girard).
HEMILEPIDOTUS NEBULOSUS Girard, 1856, p. 134 (refers to Ayres's previously unpublished name).
ARTEDIUS NOTOSPILOTUS Girard, 1856, p. 134 (Tomales Bay, California); 1857a, p. 535, pl. 24, figs. 5, 6; Jordan and Gilbert, 1881d, p. 454.
ICELUS NOTOSPILOTUS Jordan and Gilbert, 1882b, p. 690 (in part).
ASTROLYTES NOTOSPILOTUS Jordan and Evermann, 1896, p. 436; 1898a, p. 1899; 1900, fig. 689 (not. fig. 689a).
PARASTROLYTES NOTOSPILOTUS Hubbs, 1926a, p. 2.

Body subcircular in cross section or somewhat depressed anteriorly; distance from dorsal origin to pelvic base 1.0 (0.9-1.3) in width at pectoral base. Caudal peduncle moderately slender, its depth 1.3 (1.0-1.5) in diameter of orbit.

Head large, 2.5 (2.4-2.6) in standard length, broad and depressed. Length of maxillary 2.3 (2.0-2.4) in head. Snout rather long, its length 1.2 (0.9-1.5) times diameter of orbit. Nasal spines simple and sharply pointed in young specimens, becoming blunter and often developing two or three rounded points or bony bosses in very old individuals. Valvular flap of anterior nostril large, flattened, becoming strongly fringed in large specimens. Tube of posterior nostril extending about to tip of nasal spine. Eye moderate in size; orbit 4.1 (3.4-4.8) in head. Occipital region moderately depressed. A pair of spines, or very rarely three spines, behind upper posterior angle of orbit; these low and often difficult to distinguish in young specimens; becoming bifid, trifid, or quadrifid in half-grown individuals; in large adults assuming the form of heavy, abrupt, blunt elevations studded with small secondary spines. Similar spines or blunt elevations midway on each fronto-parietal ridge and at its posterior end; these reaching their full development later than postorbital spines. Posterior part of posttemporal and upper border of supracleithrum developing heavy serrations in large specimens. Upper preopercular spine heavy, with from two to six points; the upper point the longest, the lower ones often aggregated into a secondary bifid to quadrifid tip. In young specimens the second preopercular spine is acute, while the third and fourth are practically indistinguishable; with advancing age these three lower spines develop into broadly rounded, strongly serrated expansions of the preopercular border. No slit behind the last gill.

Scales extending throughout most or all of the interorbital space; sometimes a few scales under posterior part of orbit, but these often lacking. Scales of head not extending posterior to a line connecting dorsal origin and upper end of gill opening and, thus, not merging with the dorsal scale bands of the body. Dorsal scale band extending from about vertical of third dorsal spine to end of second dorsal, sometimes continued on dorsal surface of caudal peduncle by a few scattered scales, some of them occurring on midline but never forming a dense patch. The band is made up of from 24 to 31 diagonal rows of scales with from seven to eleven moderately ctenoid scales in the longest row. No scales of reduced size between dorsal scale band and first dorsal fin. Usually one to five small scattered scales behind opercular flap between the level of the pectoral base and lateral line, these often entirely missing. A pair of minute cirri just above upper lip and in line with nasal spines. Usually no cirri on nasal spines. One, two, or rarely three cirri near posterior end of maxillary. One or more small cirri on eyeball. Post-orbital cirrus comparatively small, simple in young individuals, becoming fringed in adults, very rarely missing on one side. Usually three cirri between the post-orbital cirri; these arranged in the form of a broad-based triangle, the apical cirrus anterior and sometimes double, one of the lateral ones sometimes missing. Usually one to four simple or branched cirri surmounting or directly behind each postorbital and fronto-parietal spine. An irregular transverse series of three or four simple cirri extending across top of head slightly behind each of the fronto-parietal spines; one to three cirri somewhat laterad to anterior part of fronto-parietal ridge; often one or two simple cirri slightly laterad to dorsal origin. One or two cirri midway on suborbital stay, and usually one or two cirri on each of the preopercular expansions which represent the three lower spines. One, or more rarely, two cirri directly above upper end of gill opening, and sometimes a small cirrus directly below it. From ten to 18 of the lateral-line scale margins bearing a single or double cirrus.

Base of first dorsal 1.5 (1.4-1.7) in base of second dorsal; major portion of distal profile very gently curved, almost parallel to back; the longest spine, somewhere between third and sixth, 1.7 (1.5-1.9) in base of fin. Distal profile of second dorsal gently curved, somewhat higher anteriorly than posteriorly; longest ray, somewhere between fifth and ninth, 1.9 (1.7-2.1) in base of fin; terminal membrane attached to caudal peduncle under basal 0.5 to 0.7 of depressed last ray. Anal origin under second to fourth dorsal ray, its posterior end under second to fourth ray from end of second dorsal; base of fin 1.3 (1.2-1.4) in base of second dorsal; longest ray, somewhere between sixth and tenth, about equal to or somewhat longer than longest dorsal spine and 2.0 (1.7-2.1) in base of fin; terminal membrane attached to peduncle under basal 0.1 to 0.3 of depressed last ray. Base of upper pectoral ray under third or fourth dorsal spine; fin extending to a vertical somewhere between third and sixth dorsal ray; sixth, seventh, or eighth ray longest; base of fin 2.1 (1.9-2.4) in longest ray. Pelvic base midway between snout and second, third, or fourth anal ray; fin never reaching anus, extending to vertical of last or next to last dorsal spine; its length 1.1 (1.0-1.3) times width of the pectoral base. Length of caudal 1.1 (1.0-1.2) in anal base.

Measurements in per mille of standard length, based on 21 specimens 39.2 to 134.5 mm. (average 81.9 mm.) in standard length: distance from first dorsal to pelvic 236 (206-268); distance from second dorsal to anal 194 (169-220); depth of caudal peduncle 79 (63-87); width at pectoral base 244 (214-275); length of head 405 (388-425); length of maxillary 185 (164-201); length of snout 113 (95-132); diameter of orbit 99 (86-121); distance from snout to first dorsal 325 (305-347); length of first dorsal 219 (196-243); height of first dorsal 132 (107-148); distance from snout to second dorsal 558 (538-577); length of second dorsal 334 (313-373); height of second dorsal 178 (164-189); distance from snout to anal 583 (542-618); length of anal 259 (229-274); height of anal 133 (121-143); distance from snout to pectoral 374 (354-402); width of pectoral base 143 (128-155); length of longest pectoral ray 304 (276-334); distance from snout to pelvic 318 (294-354); length of pelvic 156 (135-184); length of caudal 244 (224-264).

Fin and scale formulae: D. IX—15(14-16); A. 12(11-13); P. 16(15-17); V. I,3(2-3); C. 9(7-9); Ll. 35(35-37)+1(1-2).

Color mottled olive gray; back crossed by four irregular bars of darker color. Posterior part of head often tinged with red, orange, or purple. Sides below lateral line ocellated with round white spots, the lower ones merging into the white of the ventral surfaces. Gill membranes often dusky, tinged with yellow. Dorsal, caudal, and pectoral fins irregularly barred with light and dark gray; a black spot between first and second dorsal spines, often duller ones between third and fourth spines, and at posterior end of fin; anal and pelvics colorless.

I have examined specimens of this species from the following localities in California: off Point Reyes, Lat. 37° 59' 00" N., Long. 123° 02' 00" W.; Duxbury Point, Lat. 37° 53' 41" N., Long. 122° 42' 18" W.; Sausalito; San Pablo Bay, Lat. 38° 02' 00" N., Long. 122° 28' 00" W.; San Francisco Bay; off Alameda; lower section of San Francisco Bay; pier at north end of Van Ness Avenue, San Francisco, Lat. 37° 48' 23" N., Long. 122° 25' 34" W.; off Fort Point; Monterey Bay, Lat. 36° 56' 25" N., Long. 121° 56' 15" W.; Monterey markets; Biltmore Beach, Santa Barbara. The known range of this species is from Puget Sound, Washington, to Santa Barbara, California, and from the intertidal zone to a depth of about 25 fathoms. It is rather uncommon.

Subgenus ARTEDIUS Girard

ARTEDIUS Girard, 1856, p. 134 (genotype by subsequent designation of Jordan and Evermann, 1896, *Scorpaenichthys lateralis* Girard).
PARARTEDIUS Hubbs, 1926a, p. 3 (genotype by original designation *Parartedius hankinsoni* Hubbs).
ALLARTEDIUS Hubbs, 1926a, p. 8 (genotype by original designation *Allartedius corallinus* Hubbs).

Head large, strongly depressed. Mouth large. Snout rather long, not steep, forming an almost even and very slightly depressed continuation of occipital profile. Nasal spines sharp but small, flat, recumbent, inconspicuous, usually extending to tip of premaxillary process. Tube of the posterior nostril well developed, cylindrical or with a constricted tip. Upper orbital margin scarcely elevated, not protruding appreciably above general profile of head. Interorbital space narrow, its width less than posterior width of maxillary, practically flat in small specimens, channeled by a broad shallow groove in large ones. Occipital region flat or very slightly depressed. Upper preopercular spine well developed, the lower three obsolete and represented by very broad, gently rounded, scarcely distinguishable expansions of preopercular margin. No slit behind last gill.

No scales on head. Dorsal scale band not extending beyond base of second dorsal, usually close to lateral line and well separated from first dorsal anteriorly, diverging rather abruptly from lateral line posteriorly and approaching but not quite coming in contact with second dorsal, there being no scales at the base of any of the dorsal rays. No cirrus on upper anterior orbital margin. Genital papilla of males not enlarged.

Pectoral fin bluntly pointed; seventh or eighth pectoral ray longest.

ARTEDIUS (ARTEDIUS) CORALLINUS (Hubbs)

(Fig. 20)

ALLARTEDIUS CORALLINUS Hubbs, 1926a, p. 8 (Point Lobos, Monterey County, California).
ARTEDIUS CORALLINUS Bolin, 1937, p. 63.

Body subcircular in cross section or slightly depressed anteriorly; distance from dorsal origin to pelvic base 1.0 (0.9-1.2) in width at pectoral base. Caudal peduncle moderately slender, its depth 1.1 (0.9-1.4) in orbit.

Head 2.5 (2.5-2.7) in standard length. Maxillary extending to a vertical somewhere between posterior margin of pupil and hind end of orbit, or even slightly beyond this point in large specimens, its length 1.9 (1.8-2.1) in head. Teeth very strongly cardiform even on vomer and palatines; inner teeth on jaws somewhat larger than outer ones, the length of the longest teeth of lower jaw approximating width of mandibular band of teeth. Length of snout 1.2 (1.1-1.5) times diameter of orbit. Valve of anterior nostril small, usually simple but often becoming slightly fringed in large adults. Tube of posterior nostril very little larger than that of anterior nostril, usually barely reaching tip of nasal spine. Eye rather small; orbit 4.5 (4.0-4.8) in the head. No spines on top of head. Preopercular spine bifid, rarely trifid.

Lateral-line scales moderately ctenoid, the spines readily detected by

drawing a finger forward along the line. Dorsal scale band extending from vertical of second, third, or fourth dorsal spine to last or next to last dorsal ray; containing 39 to 49 diagonal rows of scales with from ten to 18 scales in the longest row. From three to nine scales behind opercular flap between level of pectoral base and lateral line. Sometimes a pair of well-developed cirri just above upper lip in line with nasal spines and one to three similar single cirri or small clusters of cirri posterior to these along lower suborbital margin; any or all of these may be lacking. A large cirrus, usually flattened and with expanded tip, or rarely two smaller cirri, on nasal spine; two or sometimes three cirri near posterior end of maxillary. Usually one or two flattened cirri on eyeball, these sometimes vestigial or absent. Postorbital cirrus well developed, ribbon like. A transverse line of four cirri a little behind the postorbital ones; one or two cirri in longitudinal series on each fronto-parietal ridge; no cirri on top of head between these. One or two cirri on suborbital stay and sometimes a few cirri on cheek below the stay. Three single or rarely double cirri on preopercular margin. A single cirrus on base of opercular flap. A cirrus somewhat in advance of upper end of gill opening, and rarely another somewhat mesad to this one. A cirrus on from five to 15 of the scale margins of the lateral line, some of the posterior ones enlarged and often with a second small cirrus near their bases. A number of the spines of the first dorsal tipped with small simple cirri.

Base of first dorsal 1.7 (1.5-1.8) in base of second dorsal; major portion of distal profile of fin almost straight or even very slightly concave anteriorly; fourth or fifth spine longest and 1.6 (1.4-1.8) in base of fin. The second dorsal contiguous to first dorsal or separated from it by a very narrow interspace; its origin about over anus; major portion of distal profile of fin very gently curved, almost straight, somewhat higher anteriorly than posteriorly; longest ray, somewhere between fourth and eighth, 2.1 (1.9-2.3) in base of fin; terminal membrane attached to peduncle under basal 0.5 to 0.8 of depressed last ray. Anal origin under second to fourth dorsal spine, its posterior end under second to fourth ray from end of second dorsal; base of fin 1.3 (1.1-1.4) in base of second dorsal; longest ray, somewhere between the fifth and eleventh, about equal to or somewhat longer than longest dorsal spine and 2.0 (1.9-2.2) in base of fin; terminal membrane attached to peduncle under basal 0.1 to 0.3 of depressed last ray. Base of upper pectoral ray under second or third dorsal spine; fin extending to a vertical somewhere between third and sixth dorsal ray; base of fin 2.4 (2.2-2.8) in longest ray. Pelvic base midway between snout and a point somewhere between anus and fifth anal ray; the fin extending to a vertical somewhere between fifth and last dorsal spine; its length 1.2 (1.0-1.5) times width of pectoral base; middle ray, or rarely the outer ray, longest, inner ray shortest. Caudal 1.2 (1.1-1.3) in anal base.

Measurements in per mille of standard length, based on seven specimens 42.0 to 91.5 mm. (average 65.0 mm.) in standard length: distance from first dorsal to pelvic 223 (204-251); distance from second dorsal to anal 200 (181-229); depth of caudal peduncle 78 (73-91); width at pectoral base 230 (205-260); length of head 392 (376-405); length of maxillary 198 (187-221); length of snout 110 (102-115); diameter of orbit 88 (79-100); distance from snout to first dorsal 328 (311-358); length of first dorsal 212 (195-228); height of first dorsal 130 (119-142); distance from snout to second dorsal 559 (542-573); length of second dorsal 355 (337-385); height of second dorsal 170 (148-179); distance from snout to anal 586 (535-635); length of anal 277 (258-296); height of anal 137 (129-148); distance from snout to pectoral 358 (335-386); width of pectoral base 125 (113-134); length of longest pectoral ray 297 (276-324); distance from snout to pelvic 311 (285-340); length of pelvic 151 (135-166); length of caudal 232 (216-248).

Fin and scale formulae: D. IX—16(15-16); A. 13(12-13); P. 15(15-16); V. I,3; C. 9; Ll. 35(34-35)+1.

General dorsal ground color bright pink, verging in places toward gold or lavender; back crossed by five blackish bars bordered by pale green. A somewhat interrupted streak of golden red just below lateral line. Sides with numerous round gray spots centered with yellow, the lower spots incomplete and merging into the translucent gray of ventral surfaces. Sides of head olive brown somewhat broken by paler vermiculations; light bars radiating from eye; chin brownish; profusely spotted with pale yellow. Dorsal and caudal fins irregularly barred with red; first dorsal with a black blotch at its anterior tip. Anal barred with pale yellow and dark brown. Pectorals blackish at base, barred with black or red dorsally, bordered by yellow ventrally. Pelvics colorless.

I have examined specimens of this species from the following localities in California: off Mussel Point, Lat. 36° 37' 19" N., Long. 121° 54' 12" W.; Point Lobos, Lat. 36° 31' 10" N., Long. 121° 57' 11" W.; Lat. 36° 31' 07" N., Long. 121° 57' 14" W.; Lat. 36° 31' 03" N., Long. 121° 57' 05" W.; and from Ensenada, Lower California. The first and last localities listed above represent the known limits of the range of this rare species. It has been taken in the lower intertidal region and to a depth of about five fathoms.

ARTEDIUS (ARTEDIUS) LATERALIS (Girard)

(Fig. 21)

SCORPAENICHTHYS LATERALIS Girard, 1854b, p. 145 (Monterey and San Luis Obispo).
ARTEDIUS LATERALIS Girard, 1856, p. 134; 1857b, p. 14, pl. 22a, figs. 5, 6; Jordan and Evermann, 1898a, p. 1902; Bean and Weed, 1920, p. 72 (not No. 24765); Hubbs 1926a, p. 7; Hubbs and Schultz, 1941, p. 4.
ICELUS LATERALIS Jordan and Gilbert, 1882b, p. 689.

Body subcircular in cross section anteriorly; distance from dorsal origin to pelvic base 1.0 (0.9-1.2) in width at pectoral base. Caudal peduncle moderately slender, its depth 1.1 (0.9-1.4) in orbit.

Head large, 2.6 (2.3-2.7) in standard length. The maxillary extending to a vertical somewhere between posterior margin of pupil and hind edge of orbit, or even slightly beyond this point in large specimens, its length 2.0 (1.8-2.4) in head. Teeth of moderate and uniform size, none of them approximating in length the width of the mandibular band of teeth. Length of snout about 1.2 (0.9-1.5) times diameter of orbit. Valve of anterior nostril small, usually simple but often becoming slightly fringed in large adults; tube of posterior nostril markedly larger than that of anterior nostril, extending somewhat beyond tip of nasal spine. Eye rather small; orbit 4.4 (3.7-5.1) in head. Two very low and blunt tubercles behind the upper posterior angle of each orbit in old specimens represent the postorbital spines of some related forms; no other spines on top of head. Preopercular spine usually bifid, very rarely simple or trifid.

Lateral-line scales with entire margins or very feebly ctenoid, so deeply embedded that they are not visible without dissection, feeling smooth when a finger is drawn forward along the lateral line. Dorsal scale band extending from vertical of third or fourth dorsal spine to somewhere between ultimate and antepenultimate dorsal ray; consisting of 24 to 31 diagonal rows of scales with from six to eleven moderately ctenoid scales in the longest row. No scales behind opercular flap. One or rarely two cirri at base of nasal spine, these often with expanded tips and

fringed margins. Two or three well-developed cirri near posterior end of maxillary. Often one and rarely two cirri on eyeball. One or two postorbital cirri, usually flattened and ribbon like, sometimes multifid; rarely an additional small simple cirrus on orbital margin in front of or below the postorbital cirri. Usually three cirri on top of head between the postorbital cirri; these arranged in the form of a broad-based triangle with the apex directed anteriorly; often one or two, and sometimes all three of these are missing. One to three cirri on each of the four postorbital tubercles. One or two cirri midway on fronto-parietal ridge and one at its posterior end. Frequently a single cirrus on midline between the cirri on the middle of fronto-parietal ridge, and another one laterad to them. Usually a transverse line of small cirri between the posterior ends of the fronto-parietal ridges, and often a single small cirrus on midline a little in front of dorsal origin. Usually a cirrus midway on suborbital stay and three well-developed ones on preopercular border. One to three similar cirri on base of opercular flap and one just in front of upper end of gill opening. One to three well-developed cirri on from eleven to 19 of the lateral-line scale margins. Usually several of the spines of the first dorsal fin tipped with small cirri, these best developed posteriorly.

Base of first dorsal 1.7 (1.5-1.9) in base of second dorsal; major distal profile almost straight, or even slightly concave anteriorly, almost parallel to back; longest spine, somewhere between third and sixth, 1.8 (1.6-2.3) in base of fin. Second dorsal contiguous to first dorsal or with membrane from last spine attached to basal portion of first ray; origin of fin directly over or very slightly anterior to the anus; major portion of distal margin slightly curved or almost straight and somewhat higher anteriorly than posteriorly; longest ray, somewhere between fourth and eleventh, 2.2 (1.9-2.5) in base of fin; terminal membrane attached to peduncle under basal 0.6 to 0.9 of depressed last ray. Origin of anal under second to fourth dorsal ray, its posterior end under second to fourth ray from end of second dorsal; base of fin 1.3 (1.1-1.4) in base of second dorsal; longest ray, somewhere between fourth and eleventh, intermediate in length between longest dorsal spine and longest dorsal ray and 2.1 (1.8-2.5) in base of fin; the terminal membrane attached to peduncle under basal 0.1 or 0.2 of depressed last ray. Base of upper pectoral ray under third or fourth dorsal spine; fin extending to a vertical somewhere between second and fifth dorsal ray; base of fin 2.2 (1.9-2.6) in longest ray. Pelvic base midway between snout and a point somewhere between first and fourth anal ray; fin extending to a vertical somewhere between ultimate and antepenultimate dorsal spine, its length 1.2 (1.0-1.4) times width of pectoral base; middle ray longest, inner ray shortest. Length of caudal 1.2 (1.0-1.5) in length of anal base.

Measurements in per mille of standard length, based on 50 specimens 16.1 to 124.1 mm. (average 70.1 mm.) in standard length: distance from first dorsal to pelvic 229 (201-256); distance from second dorsal to anal 208 (191-261); depth of caudal peduncle 80 (71-99); width at pectoral base 236 (211-267); length of head 391 (367-437); length of maxillary 193 (163-217); length of snout 108 (82-137); diameter of orbit 90 (74-112); distance from snout to first dorsal 322 (300-360); length of first dorsal 212 (175-241); height of first dorsal 113 (104-135); distance from snout to second dorsal 552 (498-592); length of second dorsal 362 (309-393); height of second dorsal 166 (147-189); distance from snout to anal 580 (546-621); length of anal 281 (256-317); height of anal 135 (116-156); distance from snout to pectoral 360 (330-384); width of pectoral base 134 (119-152): length of longest pectoral ray 298 (256-348); distance from snout to pelvic 329 (294-384); length of pelvic 156 (132-173); length of caudal 230 (199-298).

Fin and scale formulae: D. IX(VIII-X)—16(16-17); A. 13(12-14); P. 15(15-16); V. I,3; C. 9(8-9); Ll. 35(35-36)+1(1-2).

Ground color varying from mauve to brown or olive green. Back crossed by five wide bars of dark grayish green or brown; the space between the first two bars frequently lighter in color than the body elsewhere. Below the lateral line the ground color is broken by many round white or yellowish spots, the lower ones incomplete and merging with the white or brassy yellow color of the ventral surfaces. Chin pale brown or bluish gray flecked with many small white spots. Dorsal fins faintly and irregularly barred with pink or red; caudal more strongly barred with brown; anal faintly barred with brown and yellow. A spot of green, brown, orange, or purple on base of pectoral; the rest of the fin barred with brown and yellow. Pelvics colorless.

I have examined specimens of this species from the San Juan Islands, Washington; Turn Rock, Washington, Lat. 48° 32' 08" N., Long. 122° 57' 45" W.; and from the following localities in California: Crescent City, Lat. 41° 44' 57" N., Long. 124° 12' 28" W.; Point Delgada, Lat. 40° 01' 05" N., Long. 124° 05' 00" W.; Shelter Cove, Lat. 40° 01' 00" N., Long. 124° 04' 55" W.; south of Westport, Lat. 39° 37' 20" N., Long. 123° 47' 15" W.; north of Mendocino, Lat. 39° 19' 11" N., Long. 123° 48' 12" W.; two miles north of Bodega Head, Lat. 38° 20' 45" N., Long. 123° 04' 00" W.; cove northwest of Bodega Head, Lat. 38° 19' 01" N., Long. 123° 04' 12" W.; Bodega Head, Lat. 38° 18' 23" N., Long. 123° 03' 52" W.; Tomales Point, Lat. 38° 14' 21" N., Long. 122° 59' 29" W.; Lat. 38° 14' 16" N., Long. 122° 59' 20" W.; Duxbury Point, Lat. 37° 53' 41" N., Long. 122° 42' 18" W.; Duxbury Reef, Lat. 37° 53' 20" N., Long. 122° 41' 57" W.; Rockaway Beach; Moss Beach; Pillar Point; Half Moon Bay; Mussel Point, Lat. 36° 37' 20" N., Long. 121° 54' 15" W.; Point Pinos, Lat. 36° 38' 05" N., Long. 121° 56' 20" W.; Pescadero Point, Lat. 36° 33' 42" N., Long. 121° 57' 15" W.; Pebble Beach, Lat. 36° 34' 00" N., Long. 121° 56' 45" W.; Carmel, Lat. 36° 32' 41" N., Long. 121° 56' 58" W.; Point Lobos, Lat. 36° 31' 07" N., Long. 121° 57' 14" W.; Lat. 36° 31' 03" N., Long. 121° 57' 05" W.; Cayucos, Lat. 35° 26' 49" N., Long. 120° 54' 24" W.; Point San Luis, Lat. 35° 09' 28" N., Long. 120° 45' 43" W.; South Point, Lat. 35° 09' 04" N., Long 120° 40' 25" W.; Government Point, Lat. 34° 28' 18" N., Long. 120° 28' 39" W.; Biltmore Beach, Santa Barbara. This species is known to range from Parry Passage at the north end of Graham Island, British Columbia, to Santa Barbara, California. It is a moderately common form in the intertidal zone.

ARTEDIUS (ARTEDIUS) HANKINSONI (Hubbs)

(Fig. 22)

PARARTEDIUS HANKINSONI Hubbs, 1926a, p. 4 (Point Loma, California).

Body subcircular in cross section anteriorly, distance from dorsal origin to pelvic base about equal to width at pectoral base. Caudal peduncle rather slender, its depth about equal to diameter of orbit.

Head about 2.7 in standard length. Maxillary extending about to vertical of posterior orbital margin, its length about 2.0 in the head. Teeth of moderate and uniform size, none of them approximating in length the width of the mandibular band of teeth. Length of snout about 1.3 times diameter of orbit. Valve of anterior nostril well developed; tube of posterior nostril markedly larger than that of anterior nostril, extending about to tip of nasal spine. Eye rather small; orbit about 4.6 in head. No spines on top of the head. Preopercular spine basically bifid with each of the branches subdivided into two or three small points to form a multifid spine.

Lateral-line scales apparently with entire margins, feeling perfectly smooth when a finger is drawn forward along the lateral line. On the right side of the unique type the dorsal scale band originates under the fifth dorsal spine but is interrupted between the sixth and eighth spines; on the left side it originates about under the eighth spine, the anterior end of the band as found in related forms being entirely missing on this side and, as a consequence, the band does not closely approach the lateral line at all; posteriorly the band extends to the twelfth or thirteenth dorsal ray; it consists of from 18 to 22 diagonal rows of scales with three or four moderately ctenoid scales in the longest row. No scales behind opercular flap. A single small cirrus on mesad surface of nasal spine and one near posterior end of maxillary. No cirrus on eyeball. Postorbital cirrus small and inconspicuous. Two cirri slightly postero-mesad to each postorbital cirrus and a single cirrus somewhat laterad to it. A cirrus midway on fronto-parietal ridge, one near its posterior end, and a single cirrus somewhat postero-mesad to the latter one. A small cirrus on the upper margin of suborbital stay slightly posterior to orbit, and two similar cirri on preopercular margin. A single cirrus on base of opercular flap and one a little in front of upper end of gill opening. One or two cirri on most of the scale margins along the anterior part of the lateral line, some of them enlarged. A few of the posterior spines of first dorsal fin tipped with minute cirri.

Base of first dorsal about 1.6 in base of second dorsal; major portion of distal margin slightly rounded; fifth or sixth spines subequal and longest, about 1.7 in base of fin. Second dorsal contiguous to first dorsal, its origin almost directly over anus; major portion of distal profile gently curved, slightly higher anteriorly than posteriorly; sixth ray longest, about 2.1 in base of fin; terminal membrane attached to caudal peduncle under almost entire last ray. Origin of anal about under second dorsal ray, its posterior end about under third ray from end of second dorsal; base of fin 1.2 in base of second dorsal; ninth ray longest, intermediate in length between longest dorsal spine and longest dorsal ray and about 2.0 in base of fin; terminal membrane attached to peduncle under basal 0.2 of the depressed last ray. Base of upper pectoral ray about under third dorsal spine; fin extending about to vertical of fourth dorsal ray; base of fin 2.0 in longest ray. Base of pelvic about midway between snout and anal origin; fin extending about to vertical of next to last dorsal spine, its length about 1.2 times width of pectoral base; middle ray longest, inner ray shortest. Caudal about 1.3 in anal base.

Measurements in per mille of standard length, based on a single specimen 73.8 mm. in standard length: distance from first dorsal to pelvic 213; distance from second dorsal to anal 183; depth of caudal peduncle 79; width at pectoral base 217; length of head 375; length of maxillary 192; length of snout 103; diameter of orbit 81; distance from snout to first dorsal 321; length of first dorsal 217; height of first dorsal 125; distance from snout to second dorsal 575; length of second dorsal 347; height of second dorsal 157; distance from snout to anal 578; length of anal 279; height of anal 137; distance from snout to pectoral 355; width of pectoral base 137; length of longest pectoral ray 285; distance from snout to pelvic 293; length of pelvic 164; length of caudal 213.

Fin and scale formulae: D. IX—16; A. 13; P. 15; V. I,3; C. 9; Ll. 35(35-36)+1.

Ground color rich brown, mottled, reticulated, and somewhat rosy between the blackish cross bars. Sides below lateral line with numerous round light spots, the lower ones incomplete and merging with coloration of ventral surfaces. Sides of belly orange; lower surface of belly pale; lower edge of tail yellow. The head brownish; short radiating bars around eye, some of the lower ones consolidated to

form dark streaks, the most conspicuous extending from eye to preopercular spine, and from eye downward just behind maxillary. Fins largely reddish, the dorsals with darker, dusky red markings; first dorsal with a blackish distal blotch between the first two spines; the caudal with rather fine, the anal with coarse markings on the rays. Pectorals barred, with a large brown blotch over base of fin. Pelvics pale.

I have examined the holotype of this species, collected at Point Loma, California. It is the only specimen known.

Genus ORTHONOPIAS Starks and Mann

ORTHONOPIAS Starks and Mann, 1911, p. 11 (genotype by monotypy *Orthonopias triacis* Starks and Mann).

Teeth rather small, uniform in size, present on vomer and in a very small patch on each palatine. Four preopercular spines; the upper one strong, curved upward, bifid or trifid; the three lower ones simple; of these the upper one is sharp and slightly curved upward, the middle one similar but usually shorter and blunter, the lower one small and obtuse; all of them directed backward. Gill membranes broadly united, free from isthmus. Gills $3\frac{1}{2}$; a small pore behind last one.

Top of head above level of suborbital stay and preopercular spine densely scaled; most of the area above lateral line covered by a wide dorsal scale band. Anus markedly advanced in position, nearer to pelvic base than to anal origin in adults, somewhat nearer to anal origin in very young specimens. Genital papilla of males not enlarged.

Pelvic fins I,3, the rays not spread obliquely as in related genera, but arranged in a more or less longitudinal series with the third ray almost directly behind the first, so that the fins tend to be held in a "palm to palm" position.

This genus contains a single species.

ORTHONOPIAS TRIACIS Starks and Mann

(Fig. 23)

ORTHONOPIAS TRIACIS Starks and Mann, 1911, p. 11, fig. 1 (Cortez Banks); Gilbert, 1914, p. 137, pl. 11, fig. 2; Hubbs, 1926a, p. 11.

Body relatively slender, compressed throughout; distance from dorsal origin to pelvic base 1.3 (1.1-1.4) times width at pectoral base. Caudal peduncle slender, 1.2 (1.0-1.4) in orbit.

Head small, 3.4 (3.0-3.8) in standard length. Mouth small; maxillary extending to a vertical somewhere between anterior margin and middle of pupil, or very slightly beyond the latter point; its length 3.0 (2.8-3.3) in head. The lower jaw slightly shorter than upper, somewhat included. Snout very steep, short, its length 1.1 (0.9-1.2) in diameter of orbit. Nasal spines strong, erect, sharply pointed. Both nostrils in tubes of about equal size; the anterior one cylindrical, with a well-developed ribbon-like or fimbriated valvular expansion of its posterior rim; posterior nostril volcano shaped. Eye rather large; orbit 3.2 (3.0-3.5) in head; practically circular. Upper orbital margin scarcely elevated, not protruding notably above general profile of head. Interorbital space moderate, about 1.5 times as wide as maxillary, or slightly wider; flat in young specimens, markedly grooved in adults. Occipital region flat, without any well-defined ridges or spines. Opercular

flap ending in a rounded point, extending about 0.3 to 0.6 of an orbital diameter behind upper end of gill opening.

Lateral line descending in a practically straight line from upper border of supracleithrum to merge, at about the vertical of the tip of the pectoral fin, with the horizontal posterior portion extending along the body axis. Scales of head extending forward throughout entire interorbital space but only under posterior end of eye. Dorsal scale band originating slightly anterior to dorsal origin and tending to merge with squamation of head, extending beyond base of second dorsal posteriorly. At its anterior end the band is in contact with the lateral line, posteriorly it diverges gradually from the lateral line. The definite scale band is separated from the base of the first dorsal by a narrow, more or less naked area in which a few scales of reduced size usually occur; under the second dorsal these small scales are arranged two or three at the base of each ray except the last two; they tend to merge with the diagonal scale rows, rendering the upper margin of the dorsal scale band somewhat diffuse. Posteriorly the dorsal scale bands of the two sides merge on the dorsal surface of the caudal peduncle by means of somewhat more widely scattered scales; they are continued almost to the caudal base, a few scales occurring below base of upper caudal rays. There are from 28 to 31 diagonal rows of scales in the dorsal band between the dorsal origin and the end of the second dorsal, with from ten to 14 scales in the longest row. Lateral-line scales strongly ctenoid on upper and posterior margins. Usually a single simple cirrus at base of nasal spine. Two or three well-developed cirri near end of maxillary; sometimes a single cirrus on eyeball. No preorbital cirrus. A single, simple, unenlarged cirrus at upper posterior margin of orbit and behind this a row of three cirri along the practically undeveloped fronto-parietal ridge, the anterior one usually double and sometimes triple. A pair of small cirri between and just behind the postorbital cirri, one of these sometimes missing. A single cirrus on side of head slightly laterad to anterior fronto-parietal cirri; a pair of small cirri between and just behind the middle fronto-parietal cirri; often a single cirrus in midline just in front of dorsal fin, and a pair slightly behind this and in line with the fronto-parietal series. Usually a single cirrus midway on suborbital stay. A single cirrus at base of upper, and two or three cirri on each simple preopercular spine, and sometimes a small cirrus on preopercular border between the spines. A pair of cirri on base of opercular flap, and one just above dorsal end of gill opening. Usually a tuft of from two to six cirri just behind opercular flap and above level of pectoral base. From one to three cirri on from eleven to 18 of the lateral-line scale margins, most of these concentrated anteriorly. Often a small cirrus at tip of one or more of the spines of first dorsal fin.

Origin of first dorsal directly over or slightly behind upper end of gill opening; first two spines with approximate bases; base of fin 2.1 (1.8-2.2) in base of second dorsal; anterior part of fin profile somewhat concave due to the fact that the first two or three spines are subequal in length and abruptly shorter than the immediately succeeding spines; posteriorly the fin is bluntly rounded; longest spine, somewhere between fourth and sixth, 1.2 (1.1-1.4) in base of fin. Second dorsal contiguous to first dorsal; fin rounded anteriorly, bluntly pointed posteriorly, major portion of distal margin gently curved and slightly higher anteriorly than posteriorly; longest ray, somewhere between third and eighth, about 1.2 times length of longest dorsal spine and 2.3 (1.9-2.8) in base of fin; terminal membrane attached to peduncle under basal 0.6 to 0.8 of depressed last ray. Origin of anal under second or third dorsal ray, its posterior end under fourth to sixth ray from end of second dorsal; base of fin 1.4 (1.3-1.5) in base of second dorsal; the fin similar in shape to second dorsal but with membranes moderately incised; longest ray, somewhere between fifth and tenth, about equal to longest dorsal spine and

2.0 (1.8-2.1) in base of fin; last ray attached to caudal peduncle by membrane at extreme base only. Base of upper pectoral ray under second or third dorsal spine; fin bluntly pointed, extending to a vertical somewhere between fifth and eighth dorsal ray; seventh ray longest, 3.0 (2.9-3.2) times width of pectoral base. Pelvic base midway between snout and a point somewhere between second and sixth anal ray; fin reaching well past anus in males, extending little if any beyond anus in females; usually the anterior ray is longest, the posterior ray shortest, but the middle ray may be fully as long as the anterior ray in females, or shorter than the posterior ray in males. In males the membrane is thickened around the rays, and a free membrane (missing in females) extends along posterior margin of last ray; in neither sex is the posterior ray adnate to belly. In males the pelvic bones extend postero-ventrally slightly beyond the general ventral body profile and push out the covering muscles and skin so that the pelvic fins appear to be slightly peduncular. Caudal fin slightly rounded, its length 1.1 (1.0-1.2) in anal base.

Measurements in per mille of standard length, based on ten specimens 28.7 to 77.0 mm. (average 56.9 mm.) in standard length: distance from first dorsal to pelvic 243 (188-271); distance from second dorsal to anal 215 (171-244); depth of caudal peduncle 78 (74-82); width at pectoral base 193 (178-207); length of head 292 (264-338); length of maxillary 100 (91-110); length of snout 86 (79-92); diameter of orbit 93 (83-111); distance from snout to first dorsal 271 (254-282); the length of first dorsal 191 (181-203); height of first dorsal 151 (133-167); distance from snout to second dorsal 480 (448-502); length of second dorsal 391 (352-410); height of second dorsal 182 (159-190); distance from snout to anal 495 (471-523); length of anal 286 (269-320); height of anal 144 (129-166); distance from snout to pectoral 277 (264-291); width of pectoral base 116 (105-126); length of longest pectoral ray 350 (328-365); distance from snout to pelvic 298 (270-338); length of pelvic 99 (85-121); length of caudal 254 (237-268).

Fin and scale formulae: D. IX—17(16-18); A. 12(11-12); P. 14(13-15); V. I,3; C. 9; Ll. 37(36-38)+1.

Color very variable, ranging from green to reddish brown and orange, with spots and vermiculations of silvery white, pale blue, or red. Back crossed by four broad bars of darker or contrasting color and a Y-shaped blotch of similar color at base of caudal. Sides below lateral line with numerous round, silver-centered, light spots of various sizes. Ventral surfaces of body white. Gill membranes gray to red, speckled with small white spots. Dorsal, caudal, and pectoral fins irregularly barred with light and dark; a black spot at upper anterior corner of first dorsal. Anal dusky and pelvics black in males, colorless in females.

I have examined specimens of this species from the following localities in California: Mussel Point, Lat. 36° 37' 20" N., Long. 121° 54' 15" W.; off Pacific Grove; Pebble Beach, Lat. 36° 34' 00" N., Long. 121° 56' 45" W.; Point Lobos, Lat. 36° 31' 07" N., Long. 121° 57' 14" W.; San Miguel Island; off Ford Point, Santa Rosa Island. The known range of this rare species is from the southern end of Monterey Bay to Cortez Banks, off San Diego. It has been taken in the intertidal region and to depths of 16 fathoms.

Genus OLIGOCOTTUS Girard

OLIGOCOTTUS Girard, 1856, p. 132 (genotype by monotypy *Oligocottus maculosus* Girard).

Lower jaw shorter than upper, slightly included. Teeth small, uniform in size, present on vomer and palatines. Snout short and steep. Both nostrils in well-

developed tubes of about equal size, or the anterior one slightly the smaller, posterior margin of anterior nostril elevated into a valvular flap; the posterior nostril cylindrical or with a constricted tip. Eye somewhat longer than high, its proportional size decreasing with advancing age. Interorbital space channeled by a longitudinal groove, shallow in young specimens, becoming deeper in adults. Occipital region flat or very slightly concave, no evident spines nor well-marked ridges on top of head. Opercular flap ending in a rounded point, extending from 0.4 to 0.7 of an orbital diameter behind upper end of gill opening. Gill membranes broadly united, free from isthmus. Gills $3\frac{1}{2}$; a small pore behind the last one.

Lateral line very slightly arched over opercular flap, then descending in an almost straight line to about the vertical of the tip of the pectoral fin and continued posteriorly along the body axis. Always one or more cirri on preopercular margin, and several cirri or clusters of cirri along anterior part of lateral line. Anus immediately in advance of anal origin.

First two dorsal spines with approximate bases. Second dorsal contiguous to first dorsal or separated from it by a very narrow interspace; fin broadly rounded or with a poorly defined angle anteriorly, sharply rounded posteriorly, the main portion of the distal margin practically straight or very gently curved, decreasing somewhat in height posteriorly; longest dorsal ray markedly longer than longest dorsal spine. Anal origin somewhat more anterior, and fin base slightly longer in males than in females; entire fin of females similar in shape to second dorsal but with the membranes rather deeply incised; in males the posterior part of the fin is unmodified but one or more of the anterior rays is markedly enlarged. The pectoral fin bluntly pointed, its base broad, lower membranes rather deeply incised. Pelvics I,3, the inner ray not adnate to belly. Caudal fin slightly rounded. No split rays in any of the fins except the caudal.

This genus contains four known species. All of them are found in California.

KEY TO THE SPECIES

1a. Body covered with minute prickly scales; preopercular spine simple.....(p. 63) O. RIMENSIS.
1b. Body without visible scales; preopercular spine bifid to quadrifid, except in very young.
2a. No cirri on nasal spines and none on body above lateral line.....(p. 65) O. MACULOSUS.
2b. A well-developed cirrus on nasal spine and tufts of cirri along base of dorsal fins.
3a. No cirri on maxillary and none on suborbital stay; preopercular spine usually bifid in adults.....(p. 67) O. SNYDERI.
3b. One to four cirri on end of maxillary and a small tuft of cirri on suborbital stay; preopercular spine usually trifid in adults.....(p. 70) O. RUBELLIO.

Subgenus RUSCICULUS Greeley

RUSCICULUS Greeley, 1899, p. 13 (genotype by monotypy *Rusciculus rimensis* Greeley).
STELGIDONOTUS Gilbert and Thompson, 1905, p. 977 (genotype by original designation *Stelgidonotus latifrons* Gilbert and Thompson = *Rusciculus rimensis* Greeley).

Interorbital groove U-shaped in cross section, its bottom rounded. Upper preopercular spine well developed, simple, hooked upward; below this three smaller,

very obtuse, triangular expansions of the preopercular border, decreasing progressively in size toward the lower one which is poorly defined and almost obsolete.

Entire body except the region covered by the pectoral fins, a small area around the pelvics, and a narrow streak along base of anal covered by minute prickly scales; head naked. In males the genital papilla is modified into a slender conical penis about as long as diameter of eye; this normally sheathed in a deep depression, but capable of protrusion. It is almost impossible to determine the presence of the penis on some preserved material but if the specimen is squeezed during preservation, or if the preservative is injected into the body cavity with a slight pressure, the penis is protruded and not retracted again.

OLIGOCOTTUS (RUSCICULUS) RIMENSIS (Greeley)

(Fig. 24)

RUSCICULUS RIMENSIS Greeley, 1899, p. 13, fig. 3 (Point Lobos, Monterey County, California); Jordan and Evermann, 1900, p. 3179; Hubbs, 1926b, p. 5; 1928, p. 14; Jordan, Evermann, and Clark, 1930, p. 391.
STELGIDONOTUS LATIFRONS Gilbert and Thompson, 1905, p. 977, fig. 1 (Friday Harbor, Washington).
STELGIDINOTUS LATIFRONS Evermann and Goldsborough, 1907, p. 298.
STELGINOTUS LATIFRONS Kincaid, 1919, p. 29, fig. 63.

Body rather slender, subcircular in cross section or slightly compressed anteriorly, more strongly compressed posteriorly; distance from dorsal origin to pelvic base 1.1 (1.0-1.2) times width at pectoral base. Caudal peduncle slender, its depth 1.2 (1.0-1.4) in diameter of orbit.

Head small, 3.3 (3.0-4.1) in standard length. Mouth small; maxillary extending to a vertical somewhere between anterior orbital margin and posterior edge of pupil, its length 2.7 (2.3-2.9) in head. Snout 1.0 (0.8-1.3) times diameter of orbit. Nasal spines small, blunt, inconspicuous, about in line with profile of snout. Valvular flap of anterior nostril moderately developed, broadly triangular. Eye rather small; orbit 3.6 (3.1-4.2) in head; upper orbital margin somewhat elevated, protruding slightly above general profile of head. Interorbital space broad, its width markedly greater than distance from tip of nasal spine to tube of anterior nostril, deeply grooved.

Cirri usually simple, rarely double. A long slender cirrus at base of nasal spine, and usually one near end of maxillary. A series of four cirri extending backward from upper posterior angle of each orbit. A well-developed cirrus at base of each of the three lower preopercular spines, and a similar one on base of opercular flap. One or rarely two cirri on from 15 to 21 of the pore margins of the lateral line, most of them concentrated anteriorly, the first cirrus of this series occurring on upper posterior end of supracleithrum. No other cirri on head or body.

Origin of first dorsal about over upper end of gill opening; base of fin 1.9 (1.6-2.2) in base of second dorsal; fin evenly but rather strongly rounded; longest spine, somewhere between fourth and sixth, 2.2 (1.8-2.5) in base of fin. Longest ray of second dorsal, somewhere between third and tenth, 2.5 (2.2-3.0) in base of fin; terminal membrane attached to peduncle under basal 0.5 to 0.8 of the depressed last ray. Anal origin on a vertical somewhere between penultimate dorsal spine and first dorsal ray, its posterior end under third or fourth ray from end of second dorsal; base of fin 1.1 (1.0-1.3) in base of second dorsal. In females the longest ray, somewhere between seventh and twelfth, is a little shorter than

the longest dorsal ray and 2.4 (2.1-2.7) in base of fin. In males the first two rays are markedly thickened and enlarged, becoming longer than the remaining rays of the fin in specimens about 30 mm. in standard length, exceeding the length of the pelvic fins in adults; the third ray is sometimes slightly enlarged. Membranes between the enlarged rays deeply incised, showing no glandular thickening. Terminal membrane attached to peduncle under basal 0.3 or less of depressed last ray. Base of upper pectoral ray under first to third dorsal spine; fin extending to a vertical somewhere between fifth and eighth dorsal ray; longest ray, somewhere between fifth and eighth, 2.8 (2.5-3.3) times width of pectoral base. Pelvic base midway between snout and a point somewhere between fourth and seventh anal ray; fin extending to first or second anal ray, its length 1.3 (1.1-1.5) times width of pectoral base; middle ray usually longest, sometimes only equal to outer ray; inner ray shortest. Length of caudal 1.6 (1.3-2.0) in anal base.

Measurements in per mille of standard length, based on 24 specimens 21.8 to 45.2 mm. (average 34.0 mm.) in standard length: distance from first dorsal to the pelvic 219 (199-252); distance from second dorsal to anal 195 (177-239); depth of caudal peduncle 71 (60-83); width at pectoral base 195 (180-214); length of head 309 (243-335); length of maxillary 116 (102-138); length of snout 86 (69-99); the diameter of orbit 85 (71-93); distance from snout to first dorsal 285 (254-305); length of first dorsal 210 (186-252); height of first dorsal 96 (79-112); distance from snout to second dorsal 502 (471-523); length of second dorsal 392 (353-403); height of second dorsal 154 (132-174); distance from snout to anal 458 (392-482) in males, 496 (466-534) in females; length of anal 365 (339-411) in males, 326 (313-341) in females; height of anal, not including enlarged rays of males, 137 (118-152); distance from snout to pectoral 288 (268-314); width of pectoral base 127 (115-142); length of longest pectoral ray 366 (322-411); distance from snout to pelvic 308 (282-338); length of pelvic 182 (164-207); length of caudal 219 (203-252).

Fin and scale formulae: D. IX(VIII-X)—18(17-19); A. 14(13-15); P. 14(13-15); V. I,3; C. 9(7-9); Ll. 38(35-40)+1(0-1).

Bright specimens have the ground color red, vermiculated with light blue; back crossed by five broad olive-brown bars, each bordered by a narrow line of light blue; sides below lateral line brownish green flecked with silvery spots; ventral surfaces translucent white or brassy posteriorly; belly creamy yellow. Head slightly darker than body; a light red streak bordered by pale blue extending from eye toward posterior end of maxillary; a wider but less definite streak from eye to preopercular margin. All the fin rays green. Dorsal, caudal, and anal fins barred with red; a white or pale blue spot bordered by crimson at posterior end of first dorsal. Pectorals barred with green and white. Pelvics colorless. Dull specimens are an even greenish brown; they usually show the typical pattern faintly but sometimes not at all.

I have examined specimens of this species from False Bay, San Juan Island, Washington; and from the following localities in California: Crescent City, Lat. 41° 44' 57" N., Long. 124° 12' 28" W.; Mussel Point, Lat. 36° 37' 20" N., Long. 122° 54' 15" W.; Pescadero Point, Lat. 36° 33' 42" N., Long. 121° 57' 15" W.; Pebble Beach, Lat. 36° 34' 00" N., Long, 121° 56' 45" W.; Carmel, Lat. 36° 32' 41" N., Long. 121° 56' 58" W.; Point Lobos, Lat. 36° 31' 10" N., Long. 121° 57' 15" W.; and Lat. 36° 31' 03" N., Long. 121° 57' 05" W. The known range of the species is from Gabriola Island, British Columbia, to Gorda, California. It is a rather uncommon form in tide pools.

Subgenus OLIGOCOTTUS Girard

OLIGOCOTTUS Girard, 1856, p. 132 (genotype by monotypy *Oligocottus maculosus* Girard).
DIALARCHUS Greeley, 1899, p. 14 (genotype by monotypy *Dialarchus snyderi* Greeley).
EXIMIA Greeley, 1899, p. 18 (genotype by monotypy *Eximia rubellio* Greeley).
GREELEYA Jordan, 1920, p. 493 (substitute for *Eximia*, preoccupied, genotype designated as *Eximia rubellio* Greeley).

Body somewhat compressed throughout, usually somewhat elevated under first dorsal.

Interorbital space moderately narrow, its width equal to or slightly less than the distance from tip of nasal spine to tube of anterior nostril; its groove V-shaped in cross section, its bottom angular. Upper preopercular spine well developed, bifid to quadrifid; lower spine obsolete, represented by small bluntly angular expansions of the preopercular border which are obscured by skin but may be felt by drawing a needle across them.

No externally visible scales on head or body. Always one or more cirri on upper margin of orbit, a row of three cirri along fronto-parietal ridge, and one or two cirri or small combs diverging from the posterior end of the fronto-parietal series toward the origin of the lateral line. One to several cirri at base of the opercular flap forming a crescentic series extending toward origin of lateral line and almost reaching it in large adults. Genital papilla of males modified into a long, slender, conical, permanently external penis.

First dorsal with a sharp anterior angle, broadly rounded posteriorly, major portion of distal profile straight or very gently curved. Terminal membrane of second dorsal attached to peduncle under basal 0.8 or more of depressed last ray. Base of upper pectoral ray under second or third dorsal spine.

OLIGOCOTTUS (OLIGOCOTTUS) MACULOSUS Girard

(Fig. 25)

OLIGOCOTTUS MACULOSUS Girard, 1856, p. 133 (Tomales Bay, California); 1857a, p. 533, pl. 24, fig. 7; Greeley, 1899, p. 16; Jordan and Evermann, 1898a, p. 2871; 1900, fig. 734; Hubbs, 1926b, p. 6.
CENTRIDERMICHTHYS MACULOSUS Günther, 1860, pp. 171, 523.
OLIGOCOTTUS BOREALIS Jordan and Snyder in Jordan, 1896, p. 225 (Neah Bay, Washington); Jordan and Evermann, 1898a, p. 2014.
OLIGOCOTTUS WOSNESSENSKII Schmidt, 1903, p. 518 (Okhotsk Sea).
OLIGOCOTTUS MACULATUS Jordan, 1919, p. 269.
OLIGOCOTTUS ALASKANUS Miles, 1918, p. 93 (*lapsus calami pro Oligocottus maculosus*).

Body moderately heavy, usually slightly swollen under first dorsal; distance from dorsal origin to pelvic base 1.1 (1.0-1.3) times width at pectoral base. Caudal peduncle rather heavy, its depth 1.1 (0.8-1.6) times diameter of orbit.

Head fairly large, 3.0 (2.7-3.3) in standard length. Mouth moderate in size, maxillary extending to somewhere under pupil, or even slightly beyond the pupil in large specimens, its length 2.4 (2.1-2.9) in head. Snout 1.0 (0.7-1.5) times diameter of orbit. Nasal spines rather strong, about in line with profile of snout or slightly more erect. Valvular flap of anterior nostril poorly developed. Eye moder-

ate in size; orbit 3.7 (3.2-4.4) in the head. Upper orbital margin not noticeably elevated nor protruding above general profile of head. Groove of interorbital space comparatively shallow. Upper preopercular spine bifid or very rarely trifid.

No cirrus at base of nasal spine. Rarely a slender cirrus slightly behind and mesad to posterior nostril. One to three cirri near posterior end of maxillary. A row of cirri along upper margin of orbit; in small specimens these may be few in number or even limited to a single simple postorbital cirrus; in larger ones as many as seven cirri, some of them multifid, may form a continuous eyebrow. Cirri on top of head very variable, increasing in number with advancing age. The general pattern in large adults is usually formed by a line of three multifid cirri extending along each fronto-parietal ridge, and a parallel series of two or three similar cirri slightly laterad to these, while two transverse series of up to three cirri each extend across the top of the head in the occipital region. One to three cirri often occur in the midline anteriorly. In juveniles the cirri on top of the head are all simple and may be limited to as few as four on each side. No cirri on suborbital stay. Three cirri along lower preopercular margin; the lower one or two not developed in small specimens; the upper one, or rarely all of them, becoming double in large adults. Usually one or more cirri immediately above base of upper preopercular spine. A few simple cirri immediately behind opercular flap just above upper end of pectoral base. Each of the pores along anterior half of lateral line preceded by one to four cirri; these become few and scattered posteriorly. Typically a well-developed simple or branched cirrus at tip of each spine of first dorsal; one or two of these sometimes missing.

Origin of first dorsal directly over or slightly in advance of upper end of gill opening; base of fin 1.8 (1.6-2.2) in base of second dorsal; longest spine, somewhere between third and sixth, 2.0 (1.4-2.6) in base of fin. Longest ray of second dorsal, somewhere between second and eleventh, 2.4 (2.0-2.8) in base of fin. Anal origin on a vertical somewhere between penultimate dorsal spine and first dorsal ray, its posterior end under third to fifth ray from end of second dorsal; base of fin 1.1 (0.9-1.2) in base of second dorsal. In females the longest ray, somewhere between ninth and twelfth, is about equal to or somewhat shorter than longest dorsal ray and 2.1 (1.9-2.5) in base of fin. In males the first three rays are enlarged; the second one, about equal to or slightly longer than the first, is not quite as long as the pelvic fin. These enlarged rays are surrounded by thickened and apparently glandular membrane, the tip of the first ray extending through the thickened membrane, the second and third rays completely covered; the deeply incised membrane between the rays not thickened. In young specimens about 25 mm. in standard length the anterior rays are already enlarging but the membrane surrounding them does not become conspicuously thickened until they reach a length of about 35 mm. Terminal membrane of anal attached to peduncle under 0.3 or less of depressed last ray. Pectoral fin extending to a vertical somewhere between fifth and ninth dorsal ray; sixth, seventh, or eighth ray longest and 2.6 (2.2-3.0) times width of pectoral base. Pelvic base midway between snout and a point somewhere between third and sixth anal ray; fin extending about to or slightly beyond anus in females, to first or second anal ray in males, its length 1.4 (1.3-1.7) times width of pectoral base; middle ray longest, inner ray shortest. Length of caudal 1.4 (1.0-1.8) in anal base.

Measurements in per mille of standard length, based on 50 specimens 23.8 to 73.2 mm. (average 45.9 mm.) in standard length: distance from first dorsal to the pelvic 234 (209-266); distance from second dorsal to anal 225 (187-281); depth of caudal peduncle 95 (82-104); width at pectoral base 206 (179-241); length of head 332 (310-366); length of maxillary 137 (125-154); length of snout 92 (76-117);

diameter of orbit 90 (76-109); distance from snout to first dorsal 304 (285-332); length of first dorsal 204 (165-240); height of first dorsal 100 (87-121); distance from snout to second dorsal 532 (513-558); length of second dorsal 379 (323-409); height of second dorsal 156 (138-175); distance from snout to anal 485 (456-524) in males, 517 (496-550) in females; length of anal 368 (341-415) in males, 325 (288-343 in females; height of anal, not including enlarged rays of males, 155 (138-170); distance from snout to pectoral 325 (301-355); width of pectoral base 134 (120-155); length of longest pectoral ray 347 (293-397); distance from snout to pelvic 317 (291-363); length of pelvic 192 (166-222); length of caudal 246 (217-296).

Fin and scale formulae: D. VIII(VIII-IX)—17(16-18); A. 13(12-14); P. 14 (13-15); V. I,3; C. 9(7-10); Ll. 36(34-39)+1(1-2).

Ground color soft gray or olive to dull brown, marked dorsally with fine white spots which become larger ventrally and merge with the pale olive of belly. Back crossed by five dark brown bars. Some specimens have a series of white or pale lavender spots along the lateral line. A white spot at base of caudal, and usually on dorsal surface of caudal peduncle. Gill membranes olive, spotted with white. Fins light olive barred with brown.

I have examined specimens of this species from the following localities: Okhotsk Sea; Alaska: Karluk; Uyak Bay, Kodiak Island; Prince William Sound; Sitka; Karta Bay, Prince of Wales Island; Port Simpson, British Columbia; Washington: San Juan Islands; Parker Reef, Lat. 48° 43' 35" N., Long. 122° 53' 40" W.; Turn Rock, Lat. 48° 32' 08" N., Long. 122° 57' 45" W.; False Bay, San Juan Island; Puget Sound; Waada Island, Neah Bay; California: north of Smith River, Lat. 41° 57' 52" N., Long. 124° 12' 13" W.; Crescent City, Lat. 41° 44' 57" N., Long. 124° 12' 28" W.; south of Cape Mendocino, Lat. 40° 24' 00" N., Long. 124° 22' 55" W.; Point Delgada, Lat. 40° 01' 05" N., Long. 124° 05' 00" W.; Shelter Cove, Lat. 40° 01' 00" N., Long. 124° 04' 55" W.; Bruhel Point, Lat. 39° 36' 32" N., Long. 123° 47' 13" W.; south of Bruhel Point, Lat. 39° 36' 17" N., Long. 123° 47' 17" W.; Fort Bragg; north of Mendocino, Lat. 39° 19' 11" N., Long. 123° 48' 12" W.; reef between Iverson Landing and Arena Cove, Lat. 38° 52' 28" N., Long. 123° 39' 47" W.; two miles north of Bodega Head, Lat. 38° 20' 45" N., Long. 123° 04' 00" W.; cove northwest of Bodega Head, Lat. 38° 19' 01" N., Long. 123° 04' 12" W.; Tomales Point, Lat. 38° 14' 10" N., Long. 122° 59' 03" W.; Duxbury Point, Lat. 37° 53' 41" N., Long. 122° 42' 18" W.; Duxbury Reef, Lat. 37° 53' 20" N., Long. 122° 41' 57" W.; Moss Beach; Pillar Point; south of Yankee Point, Lat. 36° 28' 39" N., Long. 121° 56' 15" W. The known range of this species is from the Okhotsk Sea and Shimushir Island, along the Aleutians and the mainland of North America, to a little south of Yankee Point. North of San Francisco it is a common tide-pool species.

OLIGOCOTTUS (OLIGOCOTTUS) SNYDERI Greeley

(Fig. 26)

OLIGOCOTTUS MACULOSUS Jordan and Gilbert, 1881b, p. 139 (in part); 1881d, p. 455 (in part); Jordan and Evermann, 1898a, p. 2013 (not of Girard).

OLIGOCOTTUS SNYDERI Greeley in Jordan and Evermann, 1898b, p. 2871 (no type locality given).

DIALARCHUS SNYDERI Greeley, 1899, p. 14, fig. 4 (Pacific Grove, California); Jordan and Evermann, 1900, p. 3181; Bean and Weed, 1920, p. 76, pl. 4; Hubbs, 1926b, p. 8.

Body moderately heavy, somewhat elevated and swollen under first dorsal; distance from dorsal origin to pelvic base 1.2 (1.0-1.4) times width at pectoral base. Caudal peduncle rather heavy, its depth 1.1 (0.9-1.4) times diameter of eye.

Head rather small, 3.2 (3.0-3.4) in standard length. Mouth moderate; maxillary usually extending to somewhere under pupil, sometimes not quite reaching the vertical from its anterior edge, rarely extending slightly beyond pupil, its length 2.8 (2.5-3.0) in head. Snout 1.2 (0.9-1.4) times diameter of orbit. Nasal spines strongly erect, conspicuous. Valvular flap of anterior nostril well developed, triangular, sometimes showing a slight tendency toward fimbriation. Eye rather small; orbit 3.9 (3.2-4.8) in head. Upper orbital margin not elevated in young individuals, protruding somewhat above general profile of head in adults. Groove of interorbital space deep and prominent in old specimens. Upper preopercular spine usually bifid, rarely trifid, simple in very young specimens less than 14 mm. in standard length.

A single cirrus on nasal spine; none on maxillary. A series of four cirri along upper margin of orbit; the anterior one rudimentary, papilliform; the next two long and compound with several finger-like elements arising from a common base; the last cirrus either similar to the first or long and simple. One to three cirri on or near midline of interorbital space. Three compound cirri on each fronto-parietal ridge. Two or three simple or compound cirri lie slightly laterad to the fronto-parietal series, and often a few short, stubby, simple cirri between the fronto-parietal series posteriorly. No cirri midway on suborbital stay. One or two single cirri or small groups of cirri on lower preopercular margin, and a scattered patch of cirri immediately above upper preopercular spine. Several simple cirri on opercular border behind the preopercular spine. A series of cirri behind opercular flap extending upward from upper end of pectoral base. Each of the pores along the anterior half of lateral line preceded by a comb of cirri; at about the vertical of the tip of the pectoral fin these combs become reduced and scattered, or stop entirely, and only rarely do cirri occur on the posterior fourth of the lateral line. A band of cirri extending along base of dorsal fins from third or fourth dorsal spine to somewhere between last and fourth from last dorsal ray; throughout its extent this band is made up of combs of cirri at the base of each spine or ray, with the frequent exception of the first ray. Usually a longitudinal band of similar combs between lateral line and dorsal comb band; this band, centered about under origin of second dorsal, may have as many as twelve combs or as few as a single one, and rarely it may be entirely absent. Usually a single finger-like cirrus at tip of each spine of first dorsal; occasionally one or more of the spines may bear two cirri or none.

Origin of first dorsal about over upper end of gill opening; base of fin 1.8 (1.6-2.2) in length of second dorsal; longest spine, somewhere between second and sixth, 2.1 (1.7-2.6) in base of fin. Longest ray of second dorsal, somewhere between second and tenth, 2.9 (2.3-3.3) in base of fin. Anal origin on a vertical somewhere between antepenultimate dorsal spine and first dorsal ray, its posterior end under fourth, fifth, or sixth ray from end of second dorsal; base of fin 1.1 (1.0-1.3) in base of second dorsal. In females the longest ray, somewhere between ninth and thirteenth, is about equal to longest dorsal ray and 2.4 (1.9-2.9) in base of fin. In males the first ray is greatly thickened and elongated, its length in adults being markedly longer than pelvic fins and about equal to distance between dorsal origin and pelvic base; this ray is connected to the small second ray by normal unthickened membrane extending between their extreme tips; usually there is no membrane at all between the second and third rays but not infrequently a membrane extends from the second to the extreme base of the third ray forming, in

effect, two contiguous instead of entirely separate anal fins. Terminal membrane attached to peduncle under basal 0.2 or 0.3 of depressed last anal ray. Pectoral fin extending to a vertical somewhere between fifth and eighth dorsal ray; seventh or eighth ray longest, 2.7 (2.1-3.1) times width of pectoral base. Pelvic base midway between snout and fourth, fifth, or sixth anal ray; fin extending about to or very slightly beyond first anal ray, its length 1.5 (1.2-1.7) times width of pectoral base; outer ray longest, inner ray shortest. Length of caudal 1.6 (1.2-1.9) in anal base.

Measurements in per mille of standard length, based on 50 specimens 25.5 to 75.6 mm. (average 51.7 mm.) in standard length: distance from first dorsal to the pelvic 244 (216-266); distance from second dorsal to anal 244 (207-278); depth of caudal peduncle 88 (78-98); width at pectoral base 206 (172-235); length of head 312 (295-329); length of maxillary 114 (104-128); length of snout 91 (76-103); diameter of orbit 80 (65-98); distance from snout to first dorsal 280 (261-302); length of first dorsal 212 (179-246); height of first dorsal 98 (67-124); distance from snout to second dorsal 509 (474-545); length of second dorsal 419 (378-469); height of second dorsal 146 (131-168); distance from snout to anal 458 (422-510) in males, 494 (464-525) in females; length of anal 394 (373-425) in males; 353 (328-384) in females; height of anal, not including enlarged ray of males, 143 (124-174); distance from snout to pectoral 303 (283-333); width of pectoral base 127 (113-147); length of longest pectoral ray 335 (262-424); distance from snout to pelvic 311 (279-349); length of pelvic 186 (160-221); and length of caudal 232 (202-267).

Fin and scale formulae: D. VIII(VII-IX)—19(17-20); A. 14(12-15); P. 14 (13-15); V. I,3; C. 9(6-10); Ll. 38(36-39)+1(1-2).

Color extremely variable. Some specimens are the clear translucent green of sea lettuce, without any markings whatsoever, except for a series of white spots on the chin; others match perfectly the brown of the various kelps; some are spotted and vermiculated with various shades of pink and lavender to match the coralline algae. When markings do occur they consist chiefly of four or five irregular dark bars across the back and a band of similar color along the lateral line. Frequently two or three dark splotches on head and two or three dark lines radiating from eye. Dorsal, caudal, and pectoral fins often irregularly barred with light and dark; anal less markedly so; pelvics colorless. The most characteristic marking, always present, is the patch of small white spots on the chin.

I have examined specimens of this species from False Bay, San Juan Island, Washington; and from the following localities in California: north of Smith River, Lat. 41° 57' 52" N., Long. 124° 12' 13" W.; Point St. George; Crescent City, Lat. 41° 44' 57" N., Long. 124° 12' 28" W.; two miles south of Trinidad Head. Lat. 41° 01' 45" N., Long. 124° 07' 00" W.; south of Cape Mendocino, Lat. 40° 24' 00" N., Long. 124° 22' 55" W.; Point Delgada, Lat. 40° 01' 05" N., Long. 124° 05' 00" W.; Shelter Cove, Lat. 40° 01' 00" N., Long. 124° 04' 55" W.; south of Westport, Lat. 39° 37' 20" N., Long. 123° 47' 15" W.; Bruhel Point, Lat. 39° 36' 32" N., Long. 123° 47' 13" W.; Lat. 39° 36' 17" N., Long. 123° 47' 17" W.; Fort Bragg; north of Mendocino, Lat. 39° 19' 11" N., Long. 123° 48' 12" W.; two miles north of Bodega Head, Lat. 38° 20' 45" N., Long. 123° 04' 00" W.; cove northwest of Bodega Head, Lat. 38° 19' 01" N., Long. 123° 04' 12" W.; Tomales Point, Lat. 38° 14' 16" N., Long. 122° 59' 20" W.; Duxbury Point, Lat. 37° 53' 41" N., Long. 122° 42' 18" W.; Duxbury Reef, Lat. 37° 53' 20" N., Long. 122° 41' 57" W.; Bolinas Bay, Lat. 37° 54' 02" N., Long. 122° 41' 20" W.; Rockaway Beach; Moss Beach; Pillar Point; Monterey Bay; Santa Cruz; Mussel Point, Lat. 36° 37' 20" N., Long. 121° 54' 15" W.; Pacific Grove (five syntypes); Point Pinos, Lat. 36° 38' 05" N., Long. 121° 56' 20" W.;

Pescadero Point, Lat. 36° 33' 42" N., Long. 121° 57' 15" W.; Pebble Beach, Lat. 36° 34' 00" N., Long. 121° 56' 45" W.; Carmel, Lat. 36° 32' 41" N., Long. 121° 56' 58" W.; Point Lobos, Lat. 36° 31' 07" N., Long. 121° 57' 14" W.; South Point, Lat. 35° 09' 04" N., Long. 120° 40' 25" W.; Anacapa Island. The known range of this species is from Skidegate Inlet, British Columbia, to Point Loma, California. Near the extremes of its range it is quite rare, but between Puget Sound and Point Conception it is one of the commonest tide-pool fishes.

OLIGOCOTTUS (OLIGOCOTTUS) RUBELLIO (Greeley)

(Fig. 27)

OLIGOCOTTUS MACULOSUS Jordan and Gilbert, 1881b, p. 139 (in part).
EXIMIA RUBELLIO Greeley, 1899, p. 18, fig. 5 (Monterey Bay, California); Jordan and Evermann, 1900, p. 3182.
OLIGOCOTTUS RUBELLIO Starks and Morris, 1907, p. 221.
GREELEYA RUBELLIO Hubbs, 1926b, p. 7.
GREELEYA RUGELLIO Ulrey and Greeley, 1928, p. 12.

Body short and heavy, markedly elevated and swollen under first dorsal; distance from dorsal origin to pelvic base 1.2 (1.0-1.3) times width at pectoral base. Caudal peduncle moderately heavy, its depth 1.2 (0.9-1.3) times diameter of orbit.

Head large, 2.8 (2.6-3.1) in standard length. Mouth moderate in size; maxillary extending to a vertical somewhere between anterior edge and middle of pupil, its length 2.6 (2.3-3.1) in head. Snout 1.0 (0.8-1.3) times diameter of orbit. Nasal spines very strong, erect, prominent. Valvular flap of anterior nostril well developed, ribbon like, sometimes showing a slight tendency toward fimbriation. Eye rather large; orbit 3.5 (3.1-4.0) in head. Upper orbital margin slightly elevated and protruding a little above general profile of head in adults. Groove of interorbital space moderately deep. Upper preopercular spine usually trifid, sometimes bifid or quadrifid, simple in very young specimens ten mm. or less in standard length.

A long finger-like cirrus near base of nasal spine and rarely another one near its tip. One to four cirri near end of maxillary. A line of from three to six cirri along upper orbital margin; if six are present the first, third, and fifth are large, compound, and comb like, while the alternate ones are smaller and usually are simple; any or all of the smaller ones may be lacking. Three combs on each fronto-parietal ridge; two or three small combs or simple cirri laterad to each fronto-parietal ridge; often one or two simple cirri in midline of interorbital space or on top of head. A small tuft of cirri on suborbital stay and rarely a single cirrus on cheek below these. Three to five tufts of cirri along lower preopercular border and an extensive patch of scattered cirri immediately above upper preopercular spine. A number of simple cirri on opercular border behind the preopercular spine. A series of cirri extending upward behind opercular flap from upper end of pectoral base. Each of the pores along anterior half of lateral line preceded by a comb of cirri; at about the middle of the lateral line these become reduced and scattered, and none occur along its posterior third. A band of cirri extending along base of dorsal fins from third or fourth dorsal spine to last or next to last dorsal ray. This band is made up of combs of cirri, or often single cirri posteriorly, one comb occurring adjacent to the base of each ray of second dorsal, with the frequent exception of the first; opposite the first dorsal the

arrangement is often not so regular and the band is farther removed from the base of the fin than it is posteriorly. There is often a comb between the last dorsal spine and the first ray and this or the one opposite the first ray, if present, is usually markedly lower than the adjacent combs. An irregular longitudinal band of from two to seven combs between lateral line and dorsal band of combs; this band centered about under origin of second dorsal. A similar band of three to seven combs extending backward parallel to the lateral line in the pectoral axilla. A single simple cirrus at the tip of from one to three of the spines of the first dorsal fin, usually the posterior ones.

Origin of first dorsal slightly in advance of upper end of gill opening; base of fin 1.7 (1.4-2.1) in base of second dorsal; longest spine, somewhere between third and sixth, 1.9 (1.5-2.5) in base of fin. Longest ray of second dorsal, somewhere between second and eleventh, 2.2 (1.7-2.6) in base of fin. Anal origin on a vertical somewhere between last dorsal spine and first dorsal ray, its posterior end under second to fourth ray from end of second dorsal; base of fin 1.1 (1.0-1.3) in base of second dorsal. In females the longest ray, somewhere between seventh and twelfth, is intermediate in length between longest dorsal spine and longest dorsal ray and 2.3 (1.9-2.6) in base of fin. In males the first ray is greatly thickened and elongated, its length in adults being markedly greater than length of pelvic fins but shorter than the distance between dorsal origin and the pelvic base; second ray slightly longer than third but not thickened; membrane between first two rays not at all incised, its distal portion with a gland-like thickening which is very prominent in old individuals but is poorly developed in specimens less than 40 mm. in standard length; membrane from second ray deeply incised, attached to basal 0.2 or 0.3 of third ray. Terminal membrane attached to peduncle under basal 0.2 or 0.3 of depressed last anal ray. Pectoral fin extending to vertical of fifth, sixth, or seventh dorsal ray; seventh or eighth ray longest, 2.4 (2.0-2.8) times width of pectoral base. Pelvic base midway between snout and a point somewhere between fourth and seventh anal ray; fin extending to somewhere between anus and anal origin in females, to first or second anal ray in males, its length 1.3 (1.1-1.5) times width of pectoral base; middle ray slightly the longest or equal to first ray; inner ray shortest. Caudal 1.5 (1.2-1.7) in anal base.

Measurements in per mille of standard length, based on 50 specimens 23.3 to 60.2 mm. (average 47.0 mm.) in standard length: distance from first dorsal to the pelvic 267 (234-294); distance from second dorsal to anal 235 (202-260); depth of caudal peduncle 93 (86-106); width at pectoral base 230 (200-247); length of head 351 (324-378); length of maxillary 133 (114-151); length of snout 102 (86-116); diameter of orbit 101 (87-116); distance from snout to first dorsal 313 (294-334); length of first dorsal 212 (166-239); height of first dorsal 104 (92-123); distance from snout to second dorsal 541 (510-572); length of second dorsal 358 (324-402); height of second dorsal 167 (153-190); distance from snout to anal 519 (475-574) in males, 533 (503-562) in females; length of anal 343 (314-371) in males, 327 (274-357) in females; height of anal, not including enlarged rays of males, 145 (132-164); distance from snout to pectoral 332 (311-372); width of pectoral base 143 (128-160); length of longest pectoral ray 333 (302-379); distance from snout to pelvic 331 (298-387); length of pelvic 191 (170-215); length of caudal 225 (206-247).

Fin and scale formulae: D. VIII(VIII-IX)—15(15-17); A. 13(12-14); P. 14 (13-15); V. I,3; C. 9(5-10); Ll. 36(34-38)+1(1-2).

Ground color light brown, pink, red, or lavender; back crossed by four or five dark brown bars; sides of body usually brown, flecked with many pale gray or yellow spots; ventral surfaces translucent green to brassy brown. Top of head dark, often mottled with lighter shades; snout and sides of head below eyes light grayish

green, cream, or orange; dark bars radiating from eye, a very strong one extending to base of preopercular spine. Dorsal fins suffused with pale brown or red, irregularly barred with black; first dorsal marked anteriorly and posteriorly by white or pale pink spots. The caudal strongly barred with pink or brown and pale green. Pectoral base with a large brown spot, broadly bordered with white, rest of fin barred with brown or black and white or yellow. Anal faintly barred with brown or red. Ventrals translucent green.

I have examined specimens of this species from the following localities in California: Moss Beach; Sail Rock, Lat. 37° 29' 36" N., Long. 122° 29' 57" W.; Mussel Point, Lat. 36° 37' 20" N., Long. 121° 54' 15" W.; Pacific Grove (holotype); Point Pinos, Lat. 36° 38' 05" N., Long. 121° 56' 20" W.; Pescadero Point, Lat. 36° 33' 42" N., Long. 121° 57' 15" W.; Pebble Beach, Lat. 36° 34' 00" N., Long. 121° 56' 45" W.; Carmel, Lat. 36° 32' 41" N., Long. 121° 56' 58" W.; Point Lobos, Lat. 36° 31' 07" N., Long. 121° 57' 14" W.; Lat. 36° 31' 03" N., Long. 121° 57' 05" W.; Point San Luis, Lat. 35° 09' 28" N., Long. 120° 45' 43" W.; Point Loma, Lat. 32° 39' 50" N., Long. 117° 14' 30" W. The known range of this species is from Fort Bragg to Point Loma. It is an uncommon form and is taken only in the lower tide pools.

Genus CLINOCOTTUS Gill

CLINOCOTTUS Gill, 1862a, p. 166 (genotype by monotypy *Oligocottus analis* Girard).

Head somewhat depressed, its width greater than its depth. Lower jaw shorter than upper, somewhat included. Eye rather small, decreasing in proportional size with advancing age, its length slightly greater than its height; upper orbital margin not protruding above general profile of head. Only a single preopercular spine developed; the three lower spines obsolete and the lower preopercular margin evenly rounded or slightly undulating. Gill membranes broadly united, free from isthmus. Gills $3\frac{1}{2}$.

Lateral line descending in an almost straight line from upper border of supracleithrum to merge, at about the vertical of the tip of the pectoral fin, with the posterior portion of the line which extends horizontally almost along the body axis. A number of cirri on head and body; always a large postorbital cirrus and at least two cirri on each fronto-parietal ridge; one or more cirri on base of opercular flap; one or more cirri at each pore margin along anterior part of lateral line. Anus located in middle third of the distance between pelvic base and anal origin. Genital papilla of males enlarged to form a heavy penis.

Origin of second dorsal on a vertical between anus and anal origin. Anal and lower pectoral membranes deeply incised; pectoral base broad, strongly procurrent.

This genus contains five or possibly six known species. Five species occur in California.

KEY TO THE CALIFORNIA SPECIES

1a. Preopercular spine bifid or trifid; cirri and minute scales present between dorsal fins and lateral line.....(p. 73) C. ANALIS.

1b. Preopercular spine simple; neither cirri nor scales present between dorsal fins and lateral line.

2a. No cirri on maxillary; inner pelvic ray not attached to belly by membrane.

3a. Head moderately pointed and angular, definitely not hemispherical; upper lip strictly terminal; a small fleshy tubercle in median line of groove which limits the upper lip dorsally; no cirri behind opercular flap between pectoral base and lateral line.(p. 78) C. EMBRYUM.

3b. Head very bluntly rounded, hemispherical; upper lip inferior except in young specimens; no fleshy tubercle in the groove which limits the upper lip dorsally; a patch of cirri behind opercular flap between pectoral base and lateral line.

4a. Cirri in anterior half of interorbital space in specimens over 35 mm. in standard length (see note on page 77 concerning the identification of juveniles).....(p. 81) C. GLOBICEPS.

4b. No cirri in anterior half of interorbital space.....(p. 79) C. RECALVUS.

2b. One or two cirri on end of maxillary; inner pelvic ray strongly attached to belly by membrane.....(p. 84) C. ACUTICEPS.

Subgenus CLINOCOTTUS Gill

CLINOCOTTUS Gill, 1862a, p. 166 (genotype by monotypy *Oligocottus analis* Girard).
RUSULUS Starks and Mann, 1911, p. 13 (genotype by monotypy *Rusulus saburrae* Starks and Mann = *Oligocottus analis* Girard).

Preopercular spine well developed, about as long as diameter of pupil, bifid or rarely trifid. A small slit behind the last gill, its length equal to about 0.6 diameter of pupil.

A large patch of minute scales between lateral line and dorsal fins; these sometimes so deeply embedded and so nearly obscured by a dense growth of cirri in very large specimens that they may be difficult to detect. Penis bluntly conical, straight, directed backward.

Inner ray of pelvic fin not attached to belly by membrane.

CLINOCOTTUS (CLINOCOTTUS) ANALIS (Girard)

(Fig. 28)

OLIGOCOTTUS ANALIS Girard, 1858a, p. 201 (Monterey, California); R. Smith, 1880, p. 1; Jordan and Gilbert, 1881a, p. 25; 1881d, p. 455; R. S. Eigenmann, 1890, p. 182.
CENTRIDERMICHTHYS ANALIS Günther, 1860, p. 171.
COTTUS CRINIGER Günther, 1860, p. 522 (Monterey, California)
CLINOCOTTUS ANALIS Gill, 1862a, p. 166; Yarrow and Henshaw, 1878, p. 202; Jordan and Evermann, 1898a, p. 2012; Gilbert, 1899, p. 27; Greeley, 1899, p. 17; Starks and Morris, 1907, p. 220; Metz, 1912, p. 36, figs. 9-10a; Fowler, 1923a, pp. 291, 299; Ulrey and Greeley, 1928, p. 11; Jordan, Evermann, and Clark, 1930, p. 390; Hewatt, 1938, p. 288.
OLIGOCOTTUS MACULOSUS Bean and Weed, 1920, p. 76 (U.S. Nat. Mus. No. 38014 not of Girard).
CLINOCOTTUS ANALIS ANALIS Hubbs, 1926b, p. 9.
CLINOCOTTUS ANALIS AUSTRALIS Hubbs, 1926b, p. 11 (Point Loma, California); Wales, 1932, p. 168.
CLINOCOTTUS AUSTRALIS Jordan, Evermann, and Clark, 1930, p. 390.

Body rather heavy, compressed throughout, particularly posteriorly; width at pectoral base 1.2 (1.0-1.4) in distance from dorsal origin to pelvic base. Caudal peduncle heavy, its depth 1.1 (0.8-1.6) times diameter of orbit.

Head large, 3.0 (2.8-3.2) in standard length, markedly angular. Mouth not strongly inferior, the upper lip strictly terminal; moderate in size; maxillary extending to somewhere under pupil, its length 2.3 (2.0-2.7) in head. Minute teeth covering exposed head of vomer and usually present in a small oval patch on each palatine, but palatine teeth not infrequently missing from one or both sides. Snout steep, straight or slightly convex in profile, moderately pointed, rather long, 1.2 (0.9-1.6) times diameter of orbit. Nasal spines moderate in size, extending slightly beyond tip of premaxillary process, heavy but fairly sharply pointed, about in line with profile of snout or slightly more erect. Both nostrils in short tubes of about equal length; tube of anterior nostril with its posterior margin slightly produced into a poorly developed triangular flap; tube of posterior nostril not extending to tip of nasal spine, constricted distally. Orbit 3.8 (3.3-4.8) in head. Interorbital space rather narrow, its width about 1.2 to 1.7 times posterior width of maxillary, almost flat in very young specimens, strongly grooved in adults. Top of head flat, or slightly concave in old specimens which have developed low fronto-parietal ridges; without any discernible spines. Opercular flap ending in a rounded point, extending about 0.4 to 0.6 of an orbital diameter behind upper end of gill opening.

No visible scales on head. Lateral line armed with moderate-sized scales which are so deeply embedded that they leave little external trace. The large patch of minute and deeply embedded scales between the lateral line and dorsal fins is particularly dense and most readily distinguishable under the anterior half of the second dorsal; a large naked area under the anterior part of first dorsal; scales similar to those above the lateral line occur in the dorsal portion of the area between the lateral line and anal fin; sometimes a few scales behind axilla. The scales are usually more conspicuous in young specimens than in old ones. With advancing age they become obscured by cirri, are more deeply embedded, and possibly reduced, so that in some old individuals only a few scattered scales can be distinguished. One to three cirri on mesad face of nasal spine, these sometimes branched. Often one or two cirri postero-mesad to posterior nostril. One to three cirri on posterior end of maxillary. No cirri on the eyeball. Usually one to three cirri on orbital rim about over anterior margin of pupil, these simple in young specimens, becoming branched in older ones. A row of three or four usually compound cirri along upper posterior orbital margin; the second one, representing the postorbital cirrus of related forms, with a broad transverse base and numerous filaments. Often a few simple or compound cirri on median line of interorbital space, the posterior one forming the central member of a transverse series between the main postorbital cirri. Top of head covered with tufts of cirri roughly arranged in four longitudinal rows, one on each fronto-parietal ridge, and one on each side of head just laterad to these. In addition, two transverse series of cirri extend across the occipital region between the last two pairs of cirri on the fronto-parietal ridges. All of these cirri become enlarged and very complex in old specimens and appear like a sparse growth of fur on top of the head. Very rarely a small cirrus on lower margin of suborbital, and rarely one or two cirri on suborbital stay. A fringe of cirri along preopercular border below the spine and usually a few cirri above the spine. A small tuft of cirri on base of opercular flap and usually one or a few cirri immediately in front of upper end of gill opening. A comb of cirri on each scale margin along anterior part of lateral line; posteriorly these combs become irregular, few if any occurring along posterior third of lateral line, but a single

cirrus sometimes present on last scale. A series of combs, continuous anteriorly with those of occipital region, extends backward immediately above the lateral line of adults. Under the dividing line between the two dorsals it bends upward and broadens out into a wide hairy belt, continuous dorsally with a series of combs extending along the base of the dorsal fins from the middle of the first dorsal to somewhere between the middle and end of the second dorsal. In specimens less than 25 mm. in standard length none of these cirri are present; in 30-mm. specimens a few cirri are usually forming along the base of the dorsal fins, but the final pattern is not well established until a length of about 60 mm. is reached. Rarely a few simple cirri or small combs below lateral line in area covered by pectoral fins. Mature males often have a cirrus at tip of third or rarely fourth dorsal spine; with advancing age these become enlarged into flat banner-like flaps which may, in extreme cases, approximate the size of the eye. The anus of females about midway between pelvic base and anal origin; that of males a little more advanced. Length of penis in large adults slightly exceeding diameter of orbit and equal to about 0.6 width of pectoral base.

Origin of first dorsal directly over or slightly in advance of upper end of gill opening; base of fin 1.7 (1.5-2.0) in base of second dorsal; distal profile is usually flat or even slightly concave anteriorly, becoming progressively more convex posteriorly; first two spines usually abruptly shorter than the third; the longest spine, somewhere between third and fifth, 2.0 (1.4-2.5) in base of fin. Second dorsal contiguous to first dorsal or with membrane from last spine definitely attached to basal portion of first ray; fin rounded anteriorly, ending in a blunt lobe posteriorly, major portion of distal profile gently and evenly curved and slightly higher anteriorly than posteriorly; longest ray, somewhere between fourth and tenth, markedly longer than longest dorsal spine and 2.3 (2.0-2.6) in base of fin; terminal membrane attached to peduncle under basal 0.6 to 0.8 of the depressed last ray. Anal origin under second, third, or fourth dorsal ray, its posterior end under second to fourth ray from end of second dorsal; base of fin 1.3 (1.1-1.4) in base of second dorsal; shape of fin similar to that of second dorsal but posterior lobe longer and sharper; longest ray, somewhere between seventh and thirteenth, intermediate in length between longest dorsal spine and longest dorsal ray and 2.1 (1.7-2.4) in base of fin; last ray entirely free or joined to peduncle at extreme base only. Base of upper pectoral ray under second to fourth dorsal spine; fin extending to a vertical somewhere between fourth and seventh dorsal ray, bluntly pointed; seventh, eighth, or ninth ray longest and 2.4 (2.0-2.7) times width of pectoral base. Pelvic base midway between snout and the fifth, sixth, or seventh anal ray; fin extending to somewhere between tip of genital papilla and second anal ray, its length 1.5 (1.3-1.7) times width of pectoral base; middle ray longest, inner ray shortest. Caudal slightly rounded, its length 1.5 (1.3-1.7) in length of anal base.

Measurements in per mille of standard length, based on 50 specimens 30.6 to 139.3 mm. (average 79.6 mm.) in standard length: distance from first dorsal to pelvic 264 (238-305); distance from second dorsal to anal 237 (213-275); depth of caudal peduncle 98 (86-111); width at pectoral base 218 (202-239); length of head 334 (308-362); length of maxillary 145 (125-173); length of snout 107 (90-123); diameter of orbit 87 (68-106); distance from snout to first dorsal 290 (266-318); length of first dorsal 238 (200-267); height of first dorsal 122 (101-174); distance from snout to second dorsal 537 (510-570); length of second dorsal 392 (363-424); height of second dorsal 176 (157-206); distance from snout to anal 557 (518-602); length of anal 311 (281-338); height of anal 151 (132-167); distance from snout to pectoral 320 (301-350); width of pectoral base 136 (123-150); length of

longest pectoral ray 320 (292-351); distance from snout to pelvic 341 (304-396); length of pelvic 209 (181-229); length of caudal 241 (209-272).

Fin and scale formulae: D. IX(VIII-X)—17(15-18); A. 14(12-15); P. 15(14-17); V. I,3; C. 9(7-11); Ll. 35(35-36)+1.

Ground color grayish green to olive brown, flecked everywhere with fine white, yellow, and pink spots, these sometimes merging to form irregular blotches; back crossed by five or six dark bars; often a faint reddish blotch on the dorsal surface of caudal peduncle; ventral surfaces light yellow, greenish, or white. Head usually darker than body, irregularly shaded with olive or brownish red; the chin silvery white, spotted with brown or dark gray. Dorsal, caudal, anal, and pectoral fins irregularly barred with brown or olive; first dorsal with a blackish or reddish spot anteriorly; second dorsal edged with bright red spots in breeding males; pelvics colorless in females, their bases tinged with gray in males.

I have examined specimens of this species from the following localities in California: Bolinas Point, Lat. 37° 54' 13" N., Long. 122° 43' 35" W.; Duxbury Point, Lat. 37° 53' 30" N., Long. 122° 42' 02" W.; Duxbury Reef, Lat. 37° 53' 20" N., Long. 122° 41' 57" W.; Pillar Point; Pigeon Point; Santa Cruz; Monterey Bay; Mussel Point, Lat. 36° 37' 20" N., Long. 121° 54' 15" W.; Pacific Grove; Point Pinos, Lat. 36° 38' 05" N., Long. 121° 56' 20" W.; Pescadero Point, Lat. 36° 33' 42" N., Long. 121° 57' 15" W.; Pebble Beach, Lat. 36° 34' 00" N., Long. 121° 56' 45" W.; Carmel, Lat. 36° 32' 41" N., Long. 121° 56' 58" W.; Point Lobos, Lat. 36° 31' 07" N., Long. 121° 57' 14" W.; Lat. 36° 31' 03" N., Long. 121° 57' 05" W.; Cayucos, Lat. 35° 26' 49" N., Long. 120° 54' 24" W.; Point San Luis, Lat. 35° 09' 28" N., Long. 120° 45' 43" W.; South Point, Lat. 35° 09' 04" N., Long. 120° 40' 25" W.; Point Conception; Government Point, Lat. 34° 28' 18" N., Long. 120° 28' 39" W.; Bechers Bay, Santa Rosa Island, Lat. 34° 01' 10" N., Long. 120° 02' 10" W.; Rincon Point; Anacapa Island; Abalone Point, Santa Catalina Island; Portuguese Point, Lat. 33° 44' 17" N., Long. 118° 22' 21" W.; Whites Point, Lat. 33° 42' 50" N., Long. 118° 19' 03" W.; Corona del Mar; Laguna Beach, Lat. 33° 32' 25" N., Long. 117° 47' 27" W.; Lat. 33° 32' 26" N., Long. 117° 47' 24" W.; La Jolla; Cove between Goldfish Point and Shell Beach, Lat. 32° 50' 55" N., Long. 117° 16' 18" W.; Whale View Point, Lat. 32° 50' 26" N., Long. 117° 16' 58" W.; Bird Rock, Lat. 32° 48' 50" N., Long. 117° 16' 31" W.; San Diego; Point Loma, Lat. 32° 39' 50" N., Long. 117° 14' 30" W.; and from the following localities in Lower California: San Martin Island; Turtle Bay; Asuncion Point, Lat. 27° 08' 10" N., Long. 114° 17' 35" W. This species is known to range from Fort Bragg, California, to Asuncion Point, Lower California. Throughout most of its range it is one of the most common tide-pool fishes, being found even in the highest intertidal zone. It has once been taken at ten fathoms.

Subgenus BLENNICOTTUS Gill

BLENNICOTTUS Gill, 1862a, p. 166 (genotype by monotypy *Oligocottus globiceps* Girard).

ALLOCOTTUS Hubbs, 1926b, p. 14 (genotype by original designation *Oligocottus embryum* Jordan and Starks).

MONTEREYA Hubbs, 1926b, p. 16 (genotype by original designation *Blennicottus recalvus* Greeley).

Body robust, markedly compressed posteriorly. The caudal peduncle deep and heavy.

Head rather short. Mouth small. Teeth covering exposed head of vomer and in

a small oval patch on each palatine. Snout rather short, steep. Nasal spines moderate in size, usually extending to or slightly beyond tip of premaxillary process, rather heavy and blunt, about in line with profile of snout or slightly more erect. Tubes of anterior nostrils very short, their posterior rims hardly elevated, if at all; tubes of posterior nostrils much larger, extending well above tips of nasal spines, cylindrical or tapered. Eye small. Interorbital space comparatively broad, its width about 1.5 to 2.0 times posterior width of maxillary, shallowly grooved in young specimens, strongly grooved in adults; the longitudinal channel, somewhat reduced in depth, continued posteriorly in the occipital region between the fronto-parietal ridges. No evident spines on top of head; the low bony tubercles behind upper posterior margin of orbit and on fronto-parietal ridges in adults, effectively concealed by heavily pedunculate cirri. Preopercular spine short, heavy, simple, blunt. Opercular flap ending in a blunt point. A small slit behind the last gill.

No visible scales on head or body. No cirri on maxillary and none on eyeball. Postorbital cirrus large, compound, with a heavy pedunculate base; three similar cirri in a longitudinal series along each fronto-parietal ridge. No cirri on body between dorsal fins and lateral line. A comb of cirri at each of the pores along the anterior part of the lateral line in adults; these combs represented by single cirri in juvenile specimens. Penis large, simple, bent sharply forward in adults.

Origin of first dorsal directly over or slightly in advance of upper end of gill opening; fin low, with a fairly well-developed anterior angle, bluntly rounded posteriorly, main portion of distal profile rather strongly and evenly convex. Longest ray of second dorsal markedly longer than longest dorsal spine, approximately equal in length to longest anal ray. Base of upper pectoral ray under second or third dorsal spine. Middle pelvic ray longest; inner ray shortest, not adnate to belly. Caudal slightly rounded.

Although two species of this subgenus, *Clinocottus recalvus* and *C. globiceps*, are very closely related and have often been confused, the adults may readily be determined by the simple presence or absence of cirri in the anterior half of the interorbital space. Hubbs, 1926b, has presented a comparison of several other characters which are helpful, but these are certainly not as clear cut as one might believe from a perusal of his table, and some of the differences listed appear to me to be invalid. Most useful in determining young specimens are the nasal and preopercular spines, which are stronger, and the suborbital width, which is narrower in relation to the eye, in young specimens of *C. globiceps* than in most comparable specimens of *C. recalvus*. However, the proportions of these structures change with age, and they are very similar in small individuals of both species. As a result it is a practical impossibility to establish numerical values which will permit the determination of juvenile individuals. Specimens smaller than 35 mm. in standard length, the stage at which cirri begin to be moderately developed, can usually be classified only by direct comparison with other individuals of the same size and preferably of both species. If only a single small specimen is at hand it will be safest to call it *C. globiceps* if it is taken north of San Francisco, *C. recalvus* if it is taken south of Santa Cruz, and undeterminable if captured along the intervening coast.

CLINOCOTTUS (BLENNICOTTUS) EMBRYUM (Jordan and Starks)

(Fig. 29)

OLIGOCOTTUS EMBRYUM Jordan and Starks, 1895, p. 808, pl. 82 (vicinity of Neah Bay, Washington).
BLENNICOTTUS EMBRYUM Jordan and Evermann, 1896, p. 444; 1900, fig. 735; Gilbert and Burke, 1912, p. 63.
OXYCOTTUS EMBRYUM Jordan and Evermann, 1898a, p. 2016; Greeley, 1899, p. 12.
ALLOCOTTUS EMBRYUM Hubbs, 1926b, p. 14; Schultz and DeLacy, 1936b, p. 131.

Body compressed throughout, width at pectoral base 1.3 (1.2-1.5) in distance from dorsal origin to pelvic base. Caudal peduncle 1.1 (1.0-1.4) times diameter of orbit.

Head 3.4 (3.1-3.6) in standard length, somewhat angular, becoming rotund and rounded in profile in old adults, but definitely not hemispherical. The mouth not strongly inferior, the upper lip strictly terminal; maxillary usually extending to somewhere under pupil, rarely not quite reaching vertical of anterior pupillary margin, its length 2.8 (2.4-3.2) in head. Snout straight or slightly convex in profile, moderately pointed, its length 1.2 (1.0-1.5) times diameter of orbit. Preopercular spine slightly curved upward, well developed and about as long as pupil in young specimens, becoming progressively shorter and blunter with advancing age until, in very large individuals, it is nothing more than a rounded angle on the preopercular margin. Opercular flap extending about 0.2 to 0.5 of an orbital diameter behind upper end of gill opening.

A very short, heavy, blunt cirrus or dermal papilla on median line directly in the groove which limits the upper lip dorsally; it extends from the bottom of the groove just to the profile of the snout and upper lip. A well-developed cirrus on the nasal spine. A single or compound cirrus somewhat laterad to the first fronto-parietal cirrus, and usually one or two similar ones between the last fronto-parietal cirrus and origin of lateral line. Usually one or two single or double cirri on midline of interorbital space between or just anterior to the postorbital cirri. Usually one to three cirri between posterior fronto-parietal cirri, the median one often double; often a few additional simple cirri irregularly scattered on top of the head. Usually a small dermal papilla or tubercle, perhaps the basal remnant of an obsolescent cirrus, on upper anterior orbital margin, and two or three similar ones directly behind the eye and below base of postorbital cirrus. No cirri on suborbital stay; rarely a simple cirrus on preopercular spine. A few cirri on base of opercular flap; in large specimens these extend in an arc to in front of upper end of gill opening. No cirri behind opercular flap. Usually a small cirrus at tips of last one to three spines of first dorsal. The anus about midway between pelvic base and anal origin, or slightly nearer anal. Penis evenly tapered throughout, its length in large adults about equal to width of pectoral base.

Base of first dorsal 1.4 (1.2-1.6) in base of second dorsal; longest spine, somewhere between second and sixth, 2.4 (2.0-2.9) in base of fin. Second dorsal contiguous to first dorsal or with membrane from last spine definitely attached to basal portion of first ray; fin with a marked anterior angle, truncate posteriorly or ending in a short lobe, main distal profile forming a practically straight and slightly descending line; longest ray, somewhere between second and eighth, 2.2 (1.8-2.6) in base of fin; terminal membrane attached to peduncle under basal 0.6 or more of depressed last ray, its end sometimes even posterior to tip of last ray. Anal origin under second to fourth dorsal ray, its posterior end under third or fourth ray from end of second dorsal; base of fin 1.3 (1.1-1.6) in base of second

dorsal; fin rounded anteriorly, the main distal profile gently curved; longest ray, somewhere between sixth and tenth, 1.8 (1.4-2.0) in base of fin; terminal membrane attached to peduncle under basal 0.1 to 0.3 of depressed last ray. Pectoral fin extending to a vertical somewhere between fourth and sixth dorsal ray; fin bluntly pointed; seventh, eighth, or ninth ray longest; base of fin 2.6 (2.2-3.2) in length of longest ray. Pelvic base midway between snout and a point somewhere between third and fifth anal ray; fin extending to well beyond anus, sometimes as far as base of second anal ray, its length 1.7 (1.5-1.9) times width of pectoral base. Caudal 1.2 (1.0-1.5) in length of anal base.

Measurements in per mille of standard length, based on 50 specimens 18.4 to 60.7 mm. (average 38.5 mm.) in standard length: distance from first dorsal to the pelvic 255 (219-283); distance from second dorsal to anal 205 (186-231); depth of caudal peduncle 85 (73-103); width at pectoral base 194 (171-208); length of head 294 (275-322); length of maxillary 107 (95-124); length of snout 91 (77-107); the diameter of orbit 77 (67-83); distance from snout to first dorsal 273 (254-296); length of first dorsal 257 (215-291); height of first dorsal 109 (86-126); distance from snout to second dorsal 535 (504-567); length of second dorsal 352 (315-383); height of second dorsal 162 (136-182); distance from snout to anal 574 (543-628); length of anal 266 (214-292); height of anal 150 (133-169); distance from snout to pectoral 290 (271-306); width of pectoral base 135 (114-148); length of longest pectoral ray 353 (317-405); distance from snout to pelvic 334 (282-382); length of pelvic 228 (206-251); length of caudal 223 (195-250).

Fin and scale formulae: D. IX(VIII-X)—16(14-17); A. 11(9-12); P. 14(12-15); V. I,3; C. 9(6-9); Ll. 36(34-38)+1(1-2).

Color varying from light green to rich maroon; back crossed by five or six dark bars; sides flecked with small light spots; ventral surfaces white. The head marked by dark bars; lips black. Dorsal fins light near the base, dark distally; caudal mottled and anal barred with black and white; lower rays of pectorals barred with black and white; pelvics light with some dusky mottling.

I have examined specimens of this species from Attu Island and Adakh Island, Alaska; Alert Bay, British Columbia; from the following localities in Washington: San Juan Islands; Turn Rock, Lat. 48° 32' 08" N., Long. 122° 57' 45" W.; False Bay, San Juan Island; Puget Sound; Neah Bay (two syntypes); and from the following localities in California: south of Cape Mendocino, Lat. 40° 24' 00" N., Long. 124° 22' 55" W.; Point Lobos, Lat. 36° 31' 07" N., Long. 121° 57' 14" W.; south of Partington Point, Lat. 36° 10' 26" N., Long. 121° 41' 42" W. The first and last of these locality records represent the known limits of the range of this tide-pool species. It appears to be common from Puget Sound northward but it has been taken only a few times in California.

CLINOCOTTUS (BLENNICOTTUS) RECALVUS (Greeley)

(Fig. 30)

CENTRIDERMICHTHYS GLOBICEPS Günther, 1860, p. 171 (not *Oligocottus globiceps* of Girard).

OLIGOCOTTUS GLOBICEPS Jordan and Gilbert, 1882b, p. 718 (the "southern form").

BLENNICOTTUS GLOBICEPS Jordan and Starks, 1895, p. 808 (the "southern specimens"); Jordan and Evermann, 1896, p. 444 (not of Girard); 1898a, p. 2017 (the "typical form").

BLENNICOTTUS RECALVUS Greeley, 1899, p. 9, fig. 1 (Pacific Grove, California); Jordan and Evermann, 1900, p. 3178; Starks and Morris, 1907, p. 222.

MONTEREYA RECALVA Hubbs, 1926b, p. 17.

MONTEREYA RECAIVA Ulrey and Greeley, 1928, p. 10.

Body subcircular in cross section anteriorly or slightly compressed, width at pectoral base 1.1 (1.0-1.3) in distance from dorsal origin to pelvic base. The caudal peduncle 1.5 (1.1-1.8) times diameter of orbit.

Head 3.5 (3.2-3.8) in standard length, very bluntly rounded, hemispherical in shape. Mouth markedly inferior and upper lip subterminal, except in young specimens. Maxillary extending to a vertical somewhere between anterior margin of pupil and posterior margin of orbit, its length 2.2 (1.9-2.6) in head. Snout very blunt, strongly convex in profile, its length 1.3 (0.9-1.6) times diameter of orbit. The orbit 4.1 (3.4-4.9) in head. Preopercular spine well developed in young specimens, becoming proportionally broader and shorter with advancing age, about as broad as long in specimens 40 mm. in standard length, nothing more than a rounded angle on preopercular border in old individuals. Opercular flap extending from 0.6 to a full orbital diameter behind and below upper end of gill opening.

From one to several cirri on tip of nasal spine, these absent in very small specimens, as many as eight or more forming a small but dense tuft in large ones; usually one or two small cirri between anterior and posterior nostrils, and rarely a cirrus on tube of posterior nostril. A few cirri in interorbital space between or slightly in front of postorbital cirri, but none anterior to middle of pupil and none on premaxillary process. A few small cirri between fronto-parietal ridges posteriorly; from one to three simple or compound cirri slightly laterad to postorbital and first fronto-parietal cirri, and one or two simple or sometimes double cirri laterad to the posterior part of fronto-parietal ridge. A simple or rather small compound cirrus just behind and below last fronto-parietal cirrus. No cirri on suborbital stay. Usually a single cirrus or small tuft of cirri on tip of preopercular spine and often one or two small cirri just above its base; usually one to four simple cirri on preopercular margin below the spine. A single cirrus or small tuft on base of opercular flap and often a single cirrus in front of upper end of gill opening. A small fringe of cirri behind opercular flap between pectoral base and lateral line, this sometimes reduced to a single cirrus. No cirri on tips of dorsal spines. Anus somewhat nearer to anal origin than to pelvic base. Penis, when fully developed, of almost uniform diameter throughout most of its length but slightly expanded laterally near its distal end to form a pair of very blunt knobs, and terminating in a short, slightly curved horn. In large individuals the length of the penis may equal the distance from snout to pupil, or about 0.7 of the width of the pectoral base.

Base of first dorsal 1.4 (1.2-1.7) in base of second dorsal; longest spine, somewhere between third and sixth, 2.6 (1.9-3.2) in base of fin. Second dorsal contiguous to first dorsal; fin with a marked anterior angle, abruptly rounded or truncate posteriorly, main portion of distal profile straight or very gently curved and somewhat higher anteriorly than posteriorly; longest ray, somewhere between third and eighth, 2.5 (2.0-2.8) in base of fin; terminal membrane attached to the peduncle under basal 0.8 or more of depressed last ray. Anal origin under second to fourth dorsal ray, its posterior end under second to fourth ray from end of second dorsal; base of fin 1.2 (1.1-1.4) in base of second dorsal; fin broadly rounded anteriorly, ending in a bluntly pointed lobe posteriorly, the main distal profile rather strongly curved; longest ray, somewhere between seventh and eleventh, 2.1 (1.8-2.5) in base of fin; terminal membrane attached to peduncle about under basal 0.2 of depressed last ray. Pectoral extending to a vertical somewhere between second and sixth dorsal ray; fin bluntly rounded; sixth, seventh, or eighth ray longest; base of fin 2.2 (2.0-2.6) in longest ray. Pelvic base midway between snout and first or second anal ray, or sometimes a little nearer to snout than to anal origin; fin extending to somewhere between base of genital papilla and anal origin,

its length 1.4 (1.2-1.9) times width of pectoral base. Length of caudal 1.4 (0.9-1.6) in length of anal base.

Measurements in per mille of standard length, based on 50 specimens 21.0 to 108.5 mm. (average 63.8 mm.) in standard length: distance from first dorsal to pelvic 266 (223-291); distance from second dorsal to anal 243 (214-262); depth of caudal peduncle 104 (94-119); width at pectoral base 233 (201-255); length of head 284 (263-316); length of maxillary 125 (111-143); length of snout 92 (81-104); diameter of orbit 68 (57-86); distance from snout to first dorsal 252 (234-300); length of first dorsal 267 (224-299); height of first dorsal 103 (89-125); distance from snout to second dorsal 533 (517-548); length of second dorsal 377 (350-405); height of second dorsal 154 (134-190); distance from snout to anal 553 (527-579); length of anal 303 (276-328); height of anal 146 (126-167); distance from snout to pectoral 278 (253-305); width of pectoral base 149 (133-164); length of longest pectoral ray 325 (299-364); distance from snout to pelvic 292 (266-322); length of pelvic 211 (182-250); length of caudal 217 (184-265).

Fin and scale formulae: D. IX(VIII-IX)—16(15-17); A. 12(10-13); P. 14(13-15); V. I,3; C. 9(7-9); Ll. 35(33-37)+1(1-2).

Color brown, vermiculated with white, and marked dorsally by four or five wedge-shaped spots of darker color edged with white. Two pinkish spots on dorsal side of caudal peduncle and a faint shading of the same color, or of lavender, on sides of head and along anterior fourth of lateral line. Ventral surfaces dull brown or olive green. All fins coarsely barred with brown and grayish white. In some specimens the color is an almost uniform brown, in others the markings are quite prominent. Rarely young individuals are a uniform light green.

I have examined specimens of this species from the following localities in California: Bruhel Point, Lat. 39° 36' 32" N., Long. 123° 47' 13" W.; south of Bruhel Point, Lat. 39° 36' 17" N., Long. 123° 47' 17" W.; reef between Iverson Landing and Arena Cove, Lat. 38° 52' 28" N., Long. 123° 39' 47" W.; cove northwest of Bodega Head, Lat. 38° 19' 01" N., Long. 123° 04' 12" W.; Moss Beach; Sail Rock, Lat. 37° 29' 36" N., Long. 122° 29' 57" W.; Santa Cruz; Mussel Point, Lat. 36° 37' 20" N., Long. 121° 54' 15" W.; Pacific Grove (the holotype); Point Pinos, Lat. 36° 38' 05" N., Long. 121° 56' 20" W.; Pescadero Point, Lat. 36° 33' 42" N., Long. 121° 57' 15" W.; Pebble Beach, Lat. 36° 34' 00" N., Long. 121° 56' 45" W.; Carmel, Lat. 36° 32' 41" N., Long. 121° 56' 58" W.; Point Lobos, Lat. 36° 31' 07" N., Long. 121° 57' 14" W.; Lat. 36° 31' 03" N., Long. 121° 57' 05" W.; south of Arroyo de la Cruz, Lat. 35° 42' 04" N., Long. 121° 18' 04" W.; north of San Simeon, Lat. 35° 39' 08" N., Long. 121° 13' 58" W.; west of Gaviota Beach, Lat. 34° 28' 07" N., Long. 120° 13' 50" W.; Point Vicenti; and from the Coronados Islands, Lower California. The recorded range of this species is from Cape Mendocino, California, to the Coronados Islands. In the central portion of its range it is a very common tide-pool form.

CLINOCOTTUS (BLENNICOTTUS) GLOBICEPS (Girard)

(Fig. 31)

OLIGOCOTTUS GLOBICEPS Girard, 1857b, p. 12 (South Farallones, California); Jordan and Gilbert, 1881d, p. 455; Bean, 1882a, p. 251 (Sitka and Kodiak records only).

BLENNICOTTUS GLOBICEPS Gill, 1862a, p. 167; Greeley, 1899, p. 11, fig. 2; Hubbs, 1926b, p. 17.

BLENNICOTTUS GLOBICEPS BRYOSUS Jordan and Starks, 1895, p. 808 (Neah Bay, Washington); Jordan and Evermann, 1898a, p. 2017.

BLENICOTTUS GLOBICEPS Osgood, 1901, p. 20.

Body subcircular in cross section or slightly compressed anteriorly; width at pectoral base 1.2 (1.1-1.3) in distance from dorsal origin to pelvic base. The depth of caudal peduncle 1.4 (1.1-1.9) times diameter of orbit.

Head 3.4 (3.1-3.7) in standard length, very bluntly rounded, hemispherical in shape. Mouth markedly inferior and upper lip subterminal, except in young specimens. Maxillary extending to somewhere under pupil, its length 2.5 (2.1-2.7) in head. Snout very blunt, strongly convex in profile, its length 1.2 (0.9-1.6) times diameter of orbit. Orbit 3.8 (3.2-4.8) in head. Preopercular spine well developed, its length fully as great as the width of its base at all ages, curved slightly upward. Opercular flap extending about 0.5 to 0.8 of an orbital diameter below and behind upper end of gill opening.

Often one or two small cirri on tip of nasal spine, but these usually are absent; a few cirri directly behind nasal spine, between anterior and posterior nostrils, and often on tubes of posterior nostrils. Cirri present along entire median line of interorbital space; these usually beginning to develop in specimens about 35 mm. in standard length, becoming more numerous in large individuals and forming a dense fur-like streak which extends forward between the nasal spines to the tip of the premaxillary process. A sparse mat of cirri between the posterior parts of the fronto-parietal ridges in young specimens; this mat becoming dense and more extensive in large adults, some cirri even occurring anteriorly so that the patch is continuous with the cirri of the interorbital space. In specimens about 40 mm. in standard length cirri are moderately well developed in a longitudinal streak slightly laterad to the fronto-parietal ridge, in a line extending from last fronto-parietal cirrus toward origin of lateral line, and in small patches just above base of preopercular spine and on base of opercular flap; these areas expand and the cirri increase in number with advancing age until, in large adults, the entire upper and posterior surfaces of the head above the level of the preopercular spine are covered with a thick woolly growth. A streak of cirri, continuous with the dense mat on top of head, extends downward behind the preopercular border in adults. Often one or two cirri on tip of preopercular spine and usually one to four simple cirri on preopercular border below the spine. A crescentic fringe of cirri just behind opercular flap between pectoral base and lateral line, the lower end of the fringe often extending onto the extreme upper portion of the pectoral base itself. Very rarely small cirri on tips of some of the spines of first dorsal. Anus somewhat nearer to anal origin than to pectoral base. Penis, when fully developed, of almost uniform diameter throughout most of its length but slightly expanded near its distal end to form a pair of very blunt knobs, and terminating in a short, slightly curved horn. In large individuals the length of the penis may equal the distance from snout to posterior margin of orbit, or about 0.8 of the width of the pectoral base.

Base of first dorsal 1.6 (1.4-1.8) in base of second dorsal; longest spine, somewhere between third and sixth, 2.3 (1.9-3.1) in base of fin. Second dorsal contiguous to first dorsal; fin with a marked anterior angle, abruptly rounded or truncate posteriorly, main portion of distal profile straight or very gently curved and somewhat higher anteriorly than posteriorly; longest ray, somewhere between the second and tenth, 2.4 (1.9-2.9) in base of fin; terminal membrane attached to peduncle under basal 0.8 or more of depressed last ray. Anal origin under second, third, or fourth dorsal ray, its posterior end under second to fourth ray from end of second dorsal; base of fin 1.3 (1.2-1.5) in length of second dorsal; fin broadly rounded anteriorly, ending in a bluntly pointed lobe posteriorly, the main distal profile rather strongly curved; longest ray, somewhere between fifth and tenth, 1.9 (1.5-2.2) in base of fin; terminal membrane attached to peduncle about under basal

0.2 of depressed last ray. Pectoral extending to a vertical somewhere between third and seventh dorsal ray; fin bluntly rounded; seventh or eighth ray longest and 2.3 (1.9-2.9) times width of pectoral base. Pelvic base midway between snout and first, second, or third anal ray, or sometimes a little nearer to the snout than to anal origin; fin extending to somewhere between base of genital papilla and anal origin, its length 1.5 (1.4-2.0) times width of pectoral base. Length of caudal 1.2 (0.9-1.4) in length of anal base.

Measurements in per mille of standard length, based on 50 specimens 25.2 to 153.8 mm. (average 55.3 mm.) in standard length: distance from first dorsal to pelvic 268 (233-309); distance from second dorsal to anal 250 (217-315); depth of caudal peduncle 104 (93-116); width at pectoral base 225 (207-243); length of head 296 (268-326); length of maxillary 121 (105-133); length of snout 91 (79-103); diameter of orbit 77 (58-101); distance from snout to first dorsal 265 (233-294); length of first dorsal 245 (218-284); height of first dorsal 107 (83-130); distance from snout to second dorsal 526 (489-556); length of second dorsal 379 (357-406); height of second dorsal 158 (137-186); distance from snout to anal 573 (539-610); length of anal 282 (252-306); height of anal 157 (138-174); distance from snout to pectoral 289 (260-320); width of pectoral base 149 (135-176); length of longest pectoral ray 344 (299-421); distance from snout to pelvic 316 (266-375); length of pelvic 230 (204-287); length of caudal 244 (214-274).

Fin and scale formulae: D. IX(IX-X)—16(15-17); A. 11(10-12); P. 14(13-14); V. I,3; C. 9(8-9); Ll. 36(34-37)+1(1-2).

Color usually brown or olive green, more or less vermiculated with white; back crossed by four or five broad dark bars, these frequently very indistinct. Ventral surfaces pale yellow or brownish. Fins coarsely barred with brown or olive green. In some small specimens the ground color is very light and may even be a pearly white anteriorly, while the cross bars are very dark, almost black. This coloration, very conspicuous when the fish is captured, renders it extremely difficult to see on a bottom made up of broken mussel shells.

I have examined specimens of this species from the following localities in Washington: San Juan Islands; False Bay, San Juan Island; Waada Island, Neah Bay; and from the following localities in California: north of Smith River, Lat. 41° 57' 52" N., Long. 124° 12' 13" W.; Point St. George; Crescent City, Lat. 41° 44' 57" N., Long. 124° 12' 28" W.; two miles south of Trinidad, Lat. 41° 01' 45" N., Long. 124° 07' 00" W.; south of Cape Mendocino, Lat. 40° 24' 00" N., Long. 124° 22' 55" W.; Point Delgada, Lat. 40° 01' 05" N., Long. 124° 05' 00" W.; Shelter Cove, Lat. 40° 01' 00" N., Long. 124° 04' 55" W.; south of Westport, Lat. 39° 37' 20" N., Long. 123° 47' 15" W.; Bruhel Point, Lat. 39° 36' 32" N., Long. 123° 47' 13" W.; Lat. 39° 36' 17" N., Long. 123° 47' 17" W.; Fort Bragg; north of Mendocino, Lat. 39° 19' 11" N., Long. 123° 48' 12" W.; reef between Iverson Landing and Arena Cove, Lat. 38° 52' 28" N., Long. 123° 39' 47" W.; two miles north of Bodega Head, Lat. 38° 20' 45" N., Long. 123° 04' 00" W.; cove northwest of Bodega Head, Lat. 38° 19' 01" N., Long. 123° 04' 12" W.; Bodega Head, Lat. 38° 18' 23" N., Long. 123° 03' 52" W.; Tomales Point, Lat. 38° 14' 21" N., Long. 122° 59' 29" W.; Drakes Bay, Lat. 37° 59' 50" N., Long. 122° 58' 40" W.; Duxbury Reef, Lat. 37° 53' 20" N., Long. 122° 41' 57" W.; Rockaway Beach; Moss Beach; Sail Rock, Lat. 37° 29' 36" N., Long. 122° 29' 57" W.; Half Moon Bay; Pigeon Point; Mussel Point, Lat. 36° 37' 20" N., Long. 121° 54' 15" W.; south of Point Sal, Lat. 34° 51' 10" N., Long. 120° 33' 45" W.; Government Point, Lat. 34° 28' 18" N., Long. 120° 28' 39" W. The known range of this species is from Chagafka Cove, Kodiak Island, Alaska, to Government Point, California. It is a common tide-pool fish along the northern California coast but is rare south of Santa Cruz.

Subgenus OXYCOTTUS Jordan and Evermann

OXYCOTTUS Jordan and Evermann, 1898a, p. 2015 (genotype by original designation *Oligocottus acuticeps* Gilbert).

Preopercular spine well developed, about as long as diameter of the pupil, simple, sharply pointed, curved upward. No slit behind last gill.

No visible scales on head or body. No cirri on body between dorsal fins and lateral line. A wide dermal fold, secured posteriorly by a frenum, extends lateral and posterior to the genital papilla of females; in large adults the entire fold may be as large as the eye. Genital papilla of males modified to form a very large penis. This structure, practically cylindrical at the base, is somewhat depressed distally and its tip is trifid, each of the horns about 0.5 as long as diameter of orbit. In large males the penis is bent strongly forward and may extend as far as the posterior border of the gill membranes, its length sometimes equal to distance from snout to tip of preopercular spine.

Pelvic fin strongly adnate to belly, the membrane from its inner ray attached to body wall under basal 0.3 to 0.6 of depressed inner ray.

CLINOCOTTUS (OXYCOTTUS) ACUTICEPS (Gilbert)

(Fig. 32)

OLIGOCOTTUS GLOBICEPS Bean, 1882a, p. 251 (Adakh and Amchitka specimens not of Girard).

BLENNICOTTUS GLOBICEPS Jordan and Gilbert, 1899, p. 467 (Adakh and Amchitka specimens not of Girard).

OLIGOCOTTUS ACUTICEPS Gilbert, 1895, p. 432 (Unalaska, Alaska).

OXYCOTTUS ACUTICEPS Jordan and Evermann, 1898a, p. 2015; Gilbert and Burke, 1912, p. 63; Hubbs, 1926b, p. 15.

BLENNICOTTUS ACUTICEPS Jordan and Evermann, 1898b, p. 2864.

Body rather slender, except in gravid females which may be greatly distended, usually somewhat compressed throughout, particularly posteriorly; width at pectoral base 1.3 (1.1-1.4) in distance from dorsal origin to pelvic base. Caudal peduncle slender, its depth 1.1 (1.0-1.3) in diameter of orbit.

Head small, 3.4 (3.2-3.6) in standard length, markedly angular. Mouth not strongly inferior, the upper lip strictly terminal; maxillary short, extending to a vertical somewhere between anterior margin of orbit and middle of pupil, its length 2.9 (2.7-3.2) in head. A band of teeth on vomer and a very small patch of teeth on each palatine. Snout steep, straight or slightly convex in profile, rather sharply pointed, moderately long, 1.0 (0.8-1.3) times diameter of orbit. Nasal spines rather large, extending beyond tip of premaxillary process, slender and sharply pointed, about in line with profile of snout. Tubes of anterior and posterior nostrils of about equal size; anterior tube without any well-developed valvular flap; posterior tube extending about to or slightly beyond tip of nasal spine, its distal end usually constricted. Orbit 3.8 (3.2-4.8) in head. Interorbital space practically flat in young specimens, rather strongly grooved in old ones, moderately broad, its width about 2.0 times posterior width of maxillary. Top of head flat or very slightly concave between the very low and broadly rounded fronto-parietal ridges. No spines on top of head. Opercular flap bluntly rounded, extending about 0.3 to 0.6 of an orbital diameter behind upper end of gill opening.

Nasal cirrus long and slender; a slightly smaller cirrus near end of maxillary, this sometimes double. Usually a well-developed cirrus on eyeball, rarely this may be absent or double. The postorbital cirrus well developed, simple or compound, not pedunculate; two similar but smaller cirri on each fronto-parietal ridge; sometimes one or a few cirri a little laterad to origin of first dorsal. No cirri in interorbital space, nor between fronto-parietal ridges, and none on suborbital stay. One to three cirri on lower preopercular border; one on base of the opercular flap, and one or two in advance of upper end of gill opening. A single simple cirrus on each of the pore margins along the anterior half of the lateral line. A small cirrus at tip of each spine of first dorsal. Anus nearer to pelvic base than to anal origin.

Origin of first dorsal about over upper end of gill opening; base of fin 1.5 (1.2-1.9) in base of second dorsal; fin with a sharp anterior angle, bluntly rounded posteriorly, major portion of distal profile practically straight, slightly higher anteriorly than posteriorly; first, second, or third spine longest and 1.8 (1.5-2.3) in base of fin. Second dorsal contiguous to first dorsal or with membrane from last dorsal spine definitely attached to basal portion of first ray; the fin rounded anteriorly, more sharply rounded or truncate posteriorly, main portion of distal profile almost straight, slightly higher anteriorly than posteriorly; longest ray, somewhere between third and seventh, usually markedly longer than longest dorsal spine and 2.3 (2.0-2.6) in base of fin; terminal membrane attached to peduncle under 0.9 or more of depressed last ray, often posterior to its tip. The anal origin under second, third, or fourth dorsal ray, its posterior end under second to fourth ray from end of second dorsal; base of fin 1.3 (1.1-1.5) in base of the second dorsal; fin similar in shape to second dorsal but with a sharp posterior lobe; longest ray, somewhere between fifth and eleventh, usually intermediate in length between longest dorsal spine and longest dorsal ray and 2.0 (1.7-2.4) in base of fin; terminal membrane attached to peduncle under basal 0.3 to 0.6 of the depressed last ray. Pectoral fin extending to a vertical somewhere between first and fifth dorsal ray; fin bluntly pointed; sixth or seventh ray longest and 2.8 (2.1-3.6) times width of pectoral base. Pelvic base midway between snout and a point somewhere between first and third anal ray in females, and between third and sixth anal ray in males; the fin extending well beyond anus, rarely reaching anal origin, its length 1.7 (1.2-2.2) times width of pectoral base; middle ray longest; outer ray usually about equal in length to inner ray, sometimes markedly shorter. Caudal truncate or slightly rounded, its length 1.2 (1.0-1.5) in length of anal base; branching of caudal rays extremely variable, occasional specimens over 35 mm. in standard length without any branched rays at all.

Measurements in per mille of standard length, based on 50 specimens 21.2 to 53.1 mm. (average 35.3 mm.) in standard length: distance from first dorsal to the pelvic 249 (199-287); distance from second dorsal to anal 194 (169-208); depth of caudal peduncle 71 (60-85); width at pectoral base 204 (174-235); length of head 294 (279-311); length of maxillary 101 (93-113); length of snout 79 (66-90); diameter of orbit 80 (70-90); distance from snout to first dorsal 267 (248-288); the length of first dorsal 243 (204-302); height of first dorsal 134 (108-160); distance from snout to second dorsal 536 (500-575); length of second dorsal 365 (333-398); height of second dorsal 160 (138-184); distance from snout to anal 569 (538-616); length of anal 284 (246-336); height of anal 145 (126-168); distance from snout to pectoral 287 (267-314); width of pectoral base 124 (111-159); length of longest pectoral ray 349 (311-393); distance from snout to pelvic 332 (296-380); length of pelvic 204 (172-242); length of caudal 237 (212-268).

Fin and scale formulae: VIII(VII-IX)—15(14-16); A. 12(10-13); P. 14(13-15); V. I,3; C. 7(0-9); Ll. 35(33-36)+1(1-2).

Color very variable, gray, brown, olive, or green. Back crossed by six wide dark bars; a longitudinal dark streak above lateral line and another below it, the latter marked posteriorly by round white spots. Ventral surfaces white. Black bars radiating from the eye to snout, to behind maxillary, and to base of preopercular spine, the space between these dark bars often silvery white. Dorsal, caudal, anal, and pectoral fins barred with light and dark; pelvics colorless.

I have examined specimens of this species from the following localities in Alaska: Nakushin Bay, Unalaska Island; Unalaska; Karluk; Prince William Sound; from Departure Bay, British Columbia; from False Bay, San Juan Island, Washington; and from the following localities in California: north of Smith River, Lat. 41° 57' 52" N., Long. 124° 12' 13" W.; Crescent City, Lat. 41° 44' 57" N., Long. 124° 12' 28" W.; two miles south of Trinidad, Lat. 41° 01' 45" N., Long. 124° 07' 00" W.; Fort Bragg; two miles north of Bodega Head, Lat. 38° 20' 45" N., Long. 123° 04' 00" W.; Pillar Point; Pigeon Point. The known range of this species is from Attu Island, Alaska, to Pigeon Point, California. It is a moderately common intertidal form in northern California.

Genus LEIOCOTTUS Girard

LEIOCOTTUS Girard, 1856, p. 133 (genotype by monotypy *Leiocottus hirundo* Girard).
LIOCOTTUS Jordan and Gilbert, 1882b, p. 711.

Teeth present on vomer, none on palatines. Upper preopercular spine short, rather heavy, bifid; second spine very short, broad, also bifurcated; third spine represented by an inconspicuous angular point; fourth spine a scarcely evident, broadly rounded expansion of preopercular border. Gill membranes broadly united, attached to isthmus but forming a free fold across it about as wide as diameter of pupil. Gills $3\frac{1}{2}$, a small slit behind the last one, its length equal to about 0.5 diameter of pupil.

Anus markedly advanced in position, nearer to the pelvic base than to anal origin. Genital papilla of male developed into a moderately large, conical penis.

Anterior rays of first dorsal markedly produced. Pelvics I,3.

This genus contains a single species.

LEIOCOTTUS HIRUNDO Girard

(Fig. 33)

LEIOCOTTUS HIRUNDO Girard, 1856, p. 133 (San Miguel Island, California); Suckley, 1860, pl. 16, figs. 2, 3; C. H. Eigenmann, 1893, p. 168; Jordan and Evermann, 1898a, p. 2011; 1900, fig. 732; Fowler, 1923a, p. 291.
COTTUS HIRUNDO Günther, 1860, p. 166.
LIOCOTTUS HIRUNDO Jordan and Jouy, 1882, p. 6; Eigenmann and Eigenmann, 1892, p. 356.
LEIOCOTTUS HIRUNDO Ulrey and Greeley, 1928, p. 13.

Body rather slender, compressed throughout; distance from dorsal origin to pelvic base about 1.2 times width at pectoral base. Caudal peduncle moderately heavy, its depth about 1.2 times diameter of orbit.

Head rather small, about 3.1 in standard length, slightly compressed. Mouth small; maxillary extending slightly beyond vertical of anterior orbital margin, its

length about 2.8 in head. Lower jaw shorter than upper, somewhat included. Snout steep, long, about 1.7 times diameter of orbit. Nasal spines strong, erect, bifid in the specimen at hand. Anterior nostril in a very short tube, its posterior rim strongly elevated to form a triangular valvular flap; tube of posterior nostril somewhat longer, constricted at tip. Eye small; orbit about 4.5 in head, its length slightly greater than its height. The upper orbital margin scarcely elevated, not protruding notably above general profile of head. Interorbital space broad, its width almost equal to vertical diameter of orbit, channeled by a broad shallow groove. Occipital region flat; no spines nor evident ridges on top of head. Opercular flap ending in a rounded point, extending about 0.8 of an orbital diameter behind upper end of gill opening.

Lateral line descending in an even gentle curve from upper border of supracleithrum to approach body axis at about vertical of tip of pectoral fin. No scales evident on head or body. Three very minute cirri on base of nasal spine. Two or three well-developed cirri near posterior end of maxillary. A few simple or slightly branched cirri on preopercular border between the spines. A very small ribbon-like cirrus a short distance above and in front of upper end of gill opening. A comb of from one to five simple or branched cirri immediately anterior to each of the first 19 or 20 lateral-line pores. No other cirri on head or body.

Origin of first dorsal very slightly behind upper end of gill opening; base of fin about 2.2 in base of second dorsal; first two spines with approximate bases, markedly produced, extending a little beyond base of second dorsal when depressed, third spine a little longer than succeeding spines; longest spine in the unproduced portion of the fin is the sixth which is about 1.4 in base of fin. Second dorsal contiguous to first dorsal, its origin on a vertical about midway between anus and anal origin; fin evenly rounded anteriorly, more abruptly rounded posteriorly, major portion of distal profile very gently curved and somewhat higher anteriorly than posteriorly; third ray longest, intermediate in length between first and sixth dorsal spines and about 2.2 in base of fin; terminal membrane attached to peduncle about under basal 0.4 of depressed last ray. Origin of anal about under the third dorsal ray, its posterior end under penultimate dorsal ray; base of fin about 1.2 in base of second dorsal; fin similar in shape to second dorsal but lower and with its membranes moderately incised; tenth ray longest, intermediate in length between longest spine in unproduced part of first dorsal and longest dorsal ray, and about 2.2 in base of fin; last ray attached to peduncle by membrane at extreme base only. Base of upper pectoral ray under third or fourth dorsal spine, fin broadly rounded, extending about to vertical of sixth dorsal ray; sixth or seventh ray longest and about 2.2 times width of pectoral base. Pelvic base about midway between snout and seventh anal ray; fin rather long, almost reaching anal origin and about 1.1 times width of pectoral base; outer ray shorter than middle and inner rays which are subequal in length; fin not adnate to belly. Caudal truncate, its length about 1.5 in anal base.

Measurements in per mille of standard length, based on a single specimen 196.5 mm. in standard length: distance from first dorsal to pelvic 230; distance from second dorsal to anal 194; depth of caudal peduncle 84; width at pectoral base 189; length of head 326; length of maxillary 118; length of snout 177; diameter of orbit 72; distance from snout to first dorsal 299; length of first dorsal 175; height of unproduced part of first dorsal 124; distance from snout to second dorsal 489; length of second dorsal 379; height of second dorsal 175; distance from snout to anal 517; length of anal 319; height of anal 143; distance from snout to pectoral 326; width of pectoral base 134; length of longest pectoral ray 293; distance from snout to pelvic 329; length of pelvic 152; length of caudal 220.

Fin and scale formulae: D. IX—17; A. 15(15-16); P. 18(17-18); V. I,3; C. 9; Ll. 38+1(1-2).

Color olivaceous, shaded with light blue and reticulated with brownish red, the latter color predominating on head; back crossed by four brownish-red bars; abdomen orange brown with pale spots. Dorsal, anal, and pectoral fins barred with light and dark; pectoral with a dark blotch at its base; caudal orange brown with yellow bars near the tip.

Of this species I have examined only a single specimen. It was reported to have been taken off Avalon, Santa Catalina Island, but there is some doubt as to the accuracy of this locality. The known range of the species is from Santa Barbara and San Miguel Island to San Diego. Several authors have repeated Jordan and Evermann's statement that it is not rare around the Santa Barbara Islands. However, the literature appears to contain definite references to only four specimens, and the species is conspicuous by its absence in almost all museum collections.

Genus ASCELICHTHYS Jordan and Gilbert

ASCELICHTHYS Jordan and Gilbert, 1881c, p. 264 (genotype by monotypy *Ascelichthys rhodorus* Jordan and Gilbert).

Teeth on head of vomer and in a long band on each palatine. A single, well-developed, sharply pointed, and strongly hooked preopercular spine. Gill membranes broadly united, free from isthmus. Gills $3\frac{1}{2}$, no slit behind last one.

Skin tough, but loose and lax. No visible scales on head or body. Anus not markedly advanced, about a pupil diameter in front of anal origin. Anal papilla of males not enlarged.

Pelvic fins entirely absent.

This genus contains a single known species.

ASCELICHTHYS RHODORUS Jordan and Gilbert

(Fig. 34)

ASCELICHTHYS RHODORUS Jordan and Gilbert, 1881c, p. 264 (Waada Island, Washington); 1882a, p. 61; 1882b, p. 686; Jordan and Evermann, 1898a, p. 2025; 1900, fig. 739; Schultz and DeLacy, 1936b, p. 132.

Body robust, subcircular in cross section anteriorly, compressed posteriorly; depth at dorsal origin 1.0 (0.9-1.1) in width at pectoral base. Caudal peduncle heavy, its depth 1.3 (1.0-1.4) times diameter of orbit.

Head rather large, 2.7 (2.6-2.8) in standard length, somewhat depressed. Lower jaw shorter than upper, somewhat included. Mouth large; maxillary extending to or somewhat beyond vertical from posterior margin of orbit, its length 2.1 (1.9-2.2) in head. Snout rather gently sloped, its length 1.0 (0.8-1.3) in diameter of orbit. Nasal spines recumbent, entirely hidden by skin, not evident without dissection. Both nostrils in well-developed tubes; tube of anterior nostril with posterior rim slightly elevated to form a valvular flap; tube of posterior nostril somewhat larger, strongly constricted at tip. Eye rather small; orbit 4.2 (3.6-4.6) in head, its length slightly greater than its height. Interorbital space flat, its bony width about equal to diameter of pupil but difficult to measure under the thick lax skin which gives the impression of an interorbital width almost equal to

diameter of orbit. Occipital region flat, without ridges or spines. Opercular flap bluntly pointed, extending about 0.3 to 0.6 of an orbital diameter behind upper end of gill opening.

Lateral line descending in an almost straight line from upper end of gill opening to approach axis about over anal origin; anteriorly the pores are arranged in groups of three or four; posteriorly they tend to become single, although double or even triple pores may occur behind end of anal fin; a linear series of three to six minute pores just below and behind the last typical lateral-line pore, these impossible to detect unless the specimen has been cleaned of mucus. In this species the lateral-line count is made of pore groups, including the first group entirely behind the upper end of gill opening and excluding the posterior linear series of minute pores. Supraorbital cirrus well developed, consisting of three to eight finger-like processes arising in a transverse series from a common base. Three to twelve finger-like cirri immediately behind end of opercular flap; these sometimes forming a short vertical series directly above base of upper pectoral ray, more often extending in an abrupt arc to upper end of gill opening. No other cirri on head or body.

Origin of first dorsal almost directly over upper end of gill opening; base of fin 1.8 (1.4-2.1) in base of second dorsal; fin very low, its contour gently rounded throughout; first two spines with approximate bases; fifth or sixth spine longest, 2.0 (1.7-2.5) in base of fin; all spines very slender and flexible, covered by heavy loose skin and fatty tissue so that it is impossible to count them without dissection; membrane from last spine attached to basal 0.3 to 0.5 of first dorsal ray. Origin of second dorsal almost directly over anus; fin margin gently and evenly curved for most of its length, bluntly rounded posteriorly; longest ray, somewhere between eighth and thirteenth, much longer than longest dorsal spine and 2.5 (2.0-2.8) in base of fin. Except in small specimens some of the posterior rays are branched terminally, and in large individuals all rays except the first are branched; last ray not split to base; terminal membrane attached to peduncle under basal 0.6 to 0.9 of depressed last ray. Anal origin under base of second or third dorsal ray, its last ray under base of second or third ray from end of the second dorsal; shape of fin similar to that of second dorsal but membranes moderately incised; longest ray, somewhere between eleventh and thirteenth, usually intermediate in length between longest dorsal spine and longest dorsal ray and 2.1 (1.9-2.6) in base of fin; all rays simple in small specimens, those in posterior half of fin branched in large individuals; last ray not split to base; terminal membrane attached to peduncle under basal 0.2 to 0.7 of depressed last ray. Base of upper pectoral ray about under second dorsal spine; fin broadly rounded, extending to a vertical somewhere between anus and third anal ray; eighth or ninth ray longest; base of fin broad, 2.0 (1.7-2.2) in length of longest ray; a number of the upper rays, but never the first, are branched in adults; lower membranes deeply incised. Caudal strongly rounded, of moderate size, its length 1.3 (1.2-1.5) in anal base.

Measurements in per mille of standard length, based on 31 specimens 32.4 to 92.2 mm. (average 55.9 mm.) in standard length: depth at origin of first dorsal 205 (150-286); distance from second dorsal to anal 196 (165-230); depth of caudal peduncle 101 (83-116); width at pectoral base 238 (194-270); length of head 366 (336-390); length of maxillary 180 (162-192); length of snout 90 (77-108); diameter of orbit 89 (74-102); distance from snout to first dorsal 335 (301-375); length of first dorsal 222 (175-256); height of first dorsal 103 (81-131); distance from snout to second dorsal 553 (475-588); length of second dorsal 366 (312-427); height of second dorsal 154 (131-188); distance from snout to anal 577 (546-613); length of anal 284 (255-327); height of anal 130 (107-148); distance from snout to pecto-

ral 353 (327-377); width of pectoral base 130 (113-145); length of longest pectoral ray 264 (227-294); length of caudal 209 (173-235).

Fin and scale formulae: IX(VIII-IX), 18(17-19); A. 15(14-16); P. 17(16-18); C. 10(9-11); Ll. 37(35-38)+1(1-2).

General ground color dark greenish brown, often with gray saddle-like marks across the back; ventral surfaces dusky gray. All fins dark, with little or no trace of markings. Lips and edge of first dorsal sometimes tinged with bright red.

I have examined specimens of this species from the following localities in Washington: False Bay, San Juan Island; Puget Sound; Port Ludlow; Neah Bay; and from the following localities in California: northern California coast; north of Smith River, Lat. 41° 57' 52" N., Long. 124° 12' 13" W.; Crescent City, Lat. 41° 44' 57" N., Long. 124° 12' 28" W.; south of Cape Mendocino, Lat. 40° 24' 00" N., Long. 124° 22' 55" W.; north of Mendocino, Lat. 39° 19' 11" N., Long. 123° 48' 12" W.; two miles north of Bodega Head, Lat. 38° 20' 45" N., Long. 123° 04' 00" W. The known range of this species is from Sitka, Alaska, to Gualala, Mendocino County, California. It is a moderately common tide-pool form.

Genus ENOPHRYS Swainson

ENOPHRYS Swainson, 1839, p. 271 (genotype by monotypy *Cottus claviger* Cuvier and Valenciennes = *Cottus diceraus* Pallas); Rendahl, 1931b, p. 40.
ASPICOTTUS Girard, 1854a, p. 130 (genotype by subsequent designation of Jordan and Evermann, 1896, *Aspicottus bison* Girard).
CLYPEOCOTTUS Ayres, 1854b, p. 11 (genotype by monotypy *Clypeocottus robustus* Ayres = *Aspicottus bison* Girard).
ASPIDOCOTTUS Bleeker, 1859, p. xxiv (emendation of *Aspicottus*).
CERATOCOTTUS Gill, 1860, p. 165 (genotype by monotypy *Cottus diceraus* Pallas); 1862a, p. 167.

Body very heavy, almost tadpole shaped; subcircular or slightly depressed anteriorly; somewhat compressed posterior to anus.

Head massive. Mouth moderately large; lower jaw shorter than upper, slightly included. A well-developed crescentic patch of teeth on vomer; none on palatines. Snout steep. Nasal spines sharply pointed in juveniles; becoming very heavy, bluntly triangular, or even truncated in old individuals; always semirecumbent, never strongly erect. Anterior nostrils with flaring rims, their posterior margins prolonged into long flaps which are usually fringed. Orbits somewhat longer than high; upper orbital margin markedly elevated, protruding strongly above general profile of head. Occipital region concave between the well-developed fronto-parietal ridges. Four preopercular spines; the upper one long and tapered, usually extending to or even beyond end of opercular flap; the remaining spines heavy, triangular, but with acute tips. Margin of opercle armed with two smaller spines. Except in very young, all exposed bones of head marked by radiating patterns of granular osseous bosses; some of these along dorsal margin of upper preopercular spine becoming enlarged and developed into recurved hooks in adults of certain species. Opercular flap ending in a rounded point, extending from 0.5 to 0.9 of an orbital diameter behind upper end of gill opening. Gill membranes broadly joined to isthmus. Gills 4; a long slit behind the last one.

Lateral line extending almost parallel to dorsal body profile, high above middle of body and approaching axis only on the caudal peduncle; armed with large heavy scales which are so strongly ossified that they are similar in texture to

the bones of the head, their exposed surfaces densely ornamented with short blunt spines or granular bosses. Anus an orbital diameter or less in advance of anal origin. Genital papilla of males not enlarged.

Origin of first dorsal about over middle of opercular flap or somewhat behind this point, rarely directly over or even slightly behind tip of flap. First two dorsal spines with approximate bases; basal portion of first spine often markedly thickened and studded with granular bosses in adults. Second dorsal sometimes contiguous to first dorsal, but usually separated from it by an interspace which is equal to or less than diameter of pupil; terminal membrane attached to peduncle under basal 0.3 to 0.7 of depressed last ray. Anal similar in shape to the second dorsal but markedly lower and with membranes moderately incised; terminal membrane attached to peduncle under basal 0.3 to 0.5 of depressed last ray. Base of pectoral broad and strongly procurrent; fin broadly rounded; seventh or eighth ray longest; lower rays deeply incised. Pelvic I,3; base of fin midway between snout and a point somewhere between anus and third anal ray; outer ray usually shortest, middle ray longest, or subequal to inner ray which is strongly adnate to belly by membrane involving about 0.3 to 0.5 of ray. Caudal fin truncate or slightly rounded.

This genus includes four or possibly five species in the northern Pacific, and probably the European *Cottus bubalis* Euphrasen should also be included as the most primitive member of the group. The generic nomenclature has been curiously mishandled but its history has recently been well discussed by Rendahl, 1931b. Only two species are known from California.

KEY TO THE CALIFORNIA SPECIES

1a. First dorsal with 7 to 9 spines; second dorsal with 11 or 12 rays; anal with 8 or 9 rays; orbit 1.4 to 2.4 in length of maxillary, 2.1 to 3.4 in base of second dorsal, 1.5 to 2.7 in base of anal, the lower values approached only in small specimens.....(p. 91) E. BISON

1b. First dorsal with 7 spines; second dorsal with 9 rays; anal with 7 rays; orbit 1.1 to 1.3 in length of maxillary, 1.3 to 2.0 in base of second dorsal, 1.1 to 1.6 in base of anal, the higher values characteristic of adults.....(p. 93) E. TAURINUS

ENOPHRYS BISON (Girard)

(Fig. 35)

ASPICOTTUS BISON Girard, 1854a, p. 130 (San Francisco, California); 1857a, p. 535; 1857b, p. 13; Suckley, 1860, p. 353, pl. 15, fig. 1.
CLYPEOCOTTUS ROBUSTUS Ayres, 1854b, p. 11 (San Francisco, California).
COTTUS BUBALIS Günther, 1860, p. 164 (the "American variety").
ASPIDOCOTTUS BISON Gill, 1863b, p. 279; Bean, 1882a, p. 249.
ENOPHRYS BISON Jordan and Gilbert, 1882b, p. 710; H. M. Smith, 1895, p. 288; Jordan and Evermann, 1898a, p. 1938; 1900, fig. 706.
EUOPHRYS BISON Osgood, 1901, p. 20.

Distance from dorsal origin to pelvic base 1.1 (1.0-1.2) in width at pectoral base. Caudal peduncle 1.2 (0.9-1.7) in orbit.

Head 2.2 (2.0-2.4) in standard length. Maxillary extending to a vertical somewhere between posterior margin of pupil and posterior rim of orbit, its length

1.9 (1.4-2.4) times diameter of orbit and 2.4 (2.1-2.7) in head. Snout rather long, 1.1 (0.8-1.6) times diameter of orbit. Both nostrils in very short tubes, the posterior one volcano shaped. Eye comparatively small, decreasing in size with advancing age; orbit 4.5 (3.6-5.5) in head. Interorbital space broad, 1.6 (1.2-2.2) in orbit, channeled by a longitudinal groove which is well developed in adults but poorly defined in very small specimens. Each fronto-parietal ridge presenting a rather smooth profile, somewhat depressed in the middle and without marked elevations at midpoint; often ending in a blunt spine but this always low and recumbent. A rugose osseous plate between the posterior ends of the fronto-parietal ridges; this becoming evident only in specimens over 35 mm. in standard length, and sometimes undeveloped in specimens 55 mm. long.

Lateral line somewhat arched anteriorly, its posterior portion forming a straight, slightly descending line. No scales other than those of lateral line. End of maxillary bearing one to seven stubby finger-like cirri; pores of preopercular latero-sensory canal sometimes opening through short cirrus-like tubes; a fringe of cirri along margin of first dorsal fin; this fringe in very young individuals is represented by a single cirrus on the tip of each spine.

Base of first dorsal 1.4 (1.1-1.6) in base of second dorsal; fin with an abruptly rounded contour; third, fourth, or fifth spine longest, 1.5 (1.2-2.0) in base of fin. Distal contour of second dorsal sometimes strongly and evenly convex, sometimes flattened and depressed posteriorly, its posterior end bluntly rounded; longest ray, somewhere between fourth and seventh, about 1.5 times length of longest dorsal spine and 1.4 (1.2-1.6) in base of fin. Anal origin on a vertical somewhere between first and fourth dorsal ray, its last ray under one of the last four rays of second dorsal; base of fin 1.3 (1.1-1.4) in base of second dorsal; longest ray, somewhere between fourth and seventh, equal to or somewhat longer than longest dorsal spine but shorter than longest dorsal ray, 1.4 (1.2-1.7) in base of fin. Base of upper pectoral ray under or slightly in advance of dorsal origin; fin extending to a vertical somewhere between first and fourth dorsal ray; base of fin 1.7 (1.4-2.1) in longest ray. Pelvic fin extending half way to a point somewhere between second and seventh anal ray; its length 1.1 (0.9-1.3) times width of pectoral base. Caudal fin 1.2 (1.1-1.4) times length of anal base. Usually branched rays are found only in the caudal fin, but rarely one of the posterior rays of the second dorsal may be split at the extreme tip in very large specimens.

Measurements in per mille of standard length, based on 25 specimens 20.6 to 231.0 mm. (average 90.5 mm.) in standard length: distance from first dorsal to pelvic 306 (262-349); distance from second dorsal to anal 201 (170-249); depth of caudal peduncle 83 (69-100); width at pectoral base 318 (264-365); length of head 442 (415-494); length of maxillary 183 (163-204); length of snout 112 (95-131); diameter of orbit 100 (81-118); distance from snout to first dorsal 427 (399-479); length of first dorsal 193 (155-245); height of first dorsal 128 (104-155); distance from snout to second dorsal 625 (579-677); length of second dorsal 264 (227-289); height of second dorsal 188 (162-218); distance from snout to anal 618 (581-669); length of anal 208 (177-229); height of anal 163 (125-184); distance from snout to pectoral 405 (385-447); width of pectoral base 184 (160-210); length of longest pectoral ray 313 (253-348); distance from snout to pelvic 333 (296-374); length of pelvic 196 (167-245); length of caudal 248 (221-283).

Fin and scale formulae: D. VIII(VII-IX)—12(11-12); A. 9(8-9); P. 17(16-18); V. I,3; C. 9(6-9); Ll. 31(29-32)+1(0-2).

Dorsal surface olive green or brown, marbled and speckled with black and red. Back crossed by three wide dark cross bars. Ventral surfaces pale yellow. Dorsal, caudal, and pectoral fins barred and marbled with brown; anal often smudged with blackish; pelvics colorless.

I have examined specimens of this species from the San Juan Islands, and Seattle, Washington, and from the following localities in California: two miles north of Bodega Head, Lat. 38° 20' 45" N., Long. 123° 04' 00" W.; Duxbury Reef, Lat. 37° 53' 20" N., Long. 122° 41' 57" W.; Bolinas Lagoon; Sausalito; pier at north end of Van Ness Avenue, San Francisco, Lat. 37° 48' 23" N., Long. 122° 25' 34" W.; Marina Harbor, San Francisco; Monterey Bay, Lat. 36° 36' 10" N., Long. 121° 53' 00" W. The known range of the species is from Kodiak Island, Alaska, to Monterey Bay, California. References to its occurrence as far south as Point Conception are based on the misidentification by Starks and Morris, 1907, of the specimen which later was made the cotype of *Enophrys taurinus* by Gilbert, 1914. It occurs in shallow waters and frequently enters tide pools.

ENOPHRYS TAURINUS Gilbert

(Fig. 36)

ENOPHRYS BISON Starks and Morris, 1907, p. 220 (not of Girard).
ENOPHRYS TAURINUS Gilbert, 1914, p. 135, fig. 1 (Monterey Bay, near Pacific Grove, California).
ASPICOTTUS BISON Ulrey, 1929, p. 9 (not of Girard).
ASPICOTTUS TAURINUS Jordan, Evermann, and Clark, 1930, p. 381; Barnhart, 1936, p. 66; fig. 208.

Distance from dorsal origin to pelvic base 1.0 (1.0-1.1) in width at pectoral base. Caudal peduncle 1.6 (1.5-1.8) in orbit.

Head 2.2 (1.9-2.3) in standard length. Maxillary extending to somewhere under pupil, its length 1.3 (1.2-1.4) times diameter of orbit and 2.9 (2.7-3.0) in head. Snout rather short, 1.0 (1.0-1.1) in orbit. Anterior nostrils in very short tubes; posterior nostrils with very slightly elevated margins. Eye large; orbit 3.6 (3.4-3.7) in head. Interorbital space comparatively narrow, 2.2 (1.8-2.7) in orbit, channeled by a deep longitudinal groove. A heavy, blunt, supraorbital spine present in young individuals but becoming obsolete in adults. Profile of fronto-parietal ridge marked by low knob-like prominences at midpoint and posterior end. No median osseous plate between posterior ends of fronto-parietal ridges.

Lateral line practically straight throughout, without any marked anterior arch. No scales other than those of lateral line in old specimens, but entire body of very small specimens hispid with minute spinous scales. These minute scales disappear from the regions below the lateral line by the time the fish has reached a standard length of 50 mm. but may persist above the lateral line as barely perceptible vestiges in specimens 100 mm. in standard length, or even slightly longer. Usually a well-developed finger-like cirrus on end of maxillary, this sometimes absent on one side or accompanied by a smaller cirrus. Sometimes a single small cirrus on tip of each spine of first dorsal; these never forming a dense fringe.

Base of first dorsal 1.2 (1.1-1.3) in base of second dorsal; fin high, somewhat angular or pointed anteriorly; second or third spine longest, 1.3 (1.2-1.3) in base of fin. Second dorsal comparatively high, its contour rounded, the curve becoming more strongly convex posteriorly, the fin ending in a blunt point; second or third dorsal ray longest, about 1.3 times length of longest dorsal spine and 1.1 (1.0-1.3) in base of fin. Anal origin on a vertical somewhere between first and third dorsal ray, its posterior end under one of the last three rays from end of second dorsal; base of fin 1.3 (1.1-1.6) in base of second dorsal; third, fourth or fifth ray longest, about equal to longest dorsal spine and 1.2 (1.0-1.4) in

base of fin. Base of upper pectoral ray about under or slightly behind dorsal origin; fin extending to a vertical somewhere between last dorsal spine and fourth dorsal ray; base of fin 1.6 (1.2-1.9) in longest ray. Pelvic fin extending half way to a point somewhere between anus and third anal ray, its length 1.1 (0.9-1.2) times width of pectoral base. Caudal fin 1.3 (1.2-1.6) times length of anal base. About five of the posterior dorsal and anal rays branched in adults; rarely one of the upper pectoral rays may be branched.

Measurements in per mille of standard length, based on four specimens 18.3 to 136.5 mm. (average 103.8 mm.) in standard length: distance from first dorsal to pelvic 315 (295-355); distance from second dorsal to anal 200 (181-224); depth of caudal peduncle 80 (72-93); width at pectoral base 326 (289-388); length of head 453 (430-492); length of maxillary 162 (151-175); length of snout 126 (118-135); diameter of orbit 129 (119-142); distance from snout to first dorsal 447 (419-524); length of first dorsal 176 (167-182); height of first dorsal 141 (137-146); distance from snout to second dorsal 641 (623-672); length of second dorsal 210 (197-239); height of second dorsal 188 (184-197); distance from snout to anal 649 (612-676); length of anal 176 (151-196); height of anal 146 (138-158); distance from snout to pectoral 408 (390-420); width of pectoral base 182 (162-219); length of longest pectoral ray 284 (267-310); distance from snout to pelvic 342 (295-381); length of pelvic 187 (177-197); length of caudal 252 (220-295).

Fin and scale formulae: D. VII—9; A. 7; P. 17(16-18); V. I,3; C. 9(8-9); Ll. 28(27-29)+1(0-3).

Dorsal surfaces olive brown, marbled or mottled with lighter tones and with numerous small and scattered blackish-brown spots. Back crossed by three wide dark bars. Ventral surfaces white. Dorsal, caudal, and distal half of pectoral fins marbled with olive brown; basal portion of pectoral similar to dorsal surface of body. Anal slightly smudged with blackish. Pelvics colorless.

I have examined specimens of this species from the following localities in California: Monterey Bay, Lat. 36° 36' 30" N., Long. 121° 53' 00" W.; Lat. 36° 38' 00" N., Long. 121° 54' 00" W.; off Richardson Rock, Lat. 34° 12' 30" N., Long. 120° 32' 30" W. (the paratype). The known range of the species is from Monterey Bay to San Nicolas Island, in depths of from six to 145 fathoms. It is rare.

Genus ZESTICELUS Jordan and Evermann

ZESTICELUS Jordan and Evermann, 1896, p. 443 (genotype by original designation *Acanthocottus profundorum* Gilbert).

Bones of the head cavernous, the pores of the latero-sensory system excessively enlarged. Teeth on vomer; none on palatines, The preopercular border armed with four simple spines. Gill membranes broadly united, joined to isthmus near their united posterior margin which forms a free fold about as wide as diameter of pupil, or somewhat less. Gills $3\frac{1}{2}$; no slit behind the last one; pseudobranchiae consisting of only four or five long filaments.

No visible scales on head or body. No cirri developed. Anus not notably advanced in position. Genital papilla of males not enlarged.

Spines of first dorsal evenly spaced, the first two not approximated. Pelvic fins I,2, rarely I,3.

This deep-water genus of the northern Pacific contains two species, only one of which is known from the waters of California.

ZESTICELUS PROFUNDORUM (Gilbert)

(Fig. 37)

ACANTHOCOTTUS PROFUNDORUM Gilbert, 1895, p. 423, pl. 27 (Albatross station 3329, north of Unalaska Island, Alaska).
ZESTICELUS PROFUNDORUM Jordan and Evermann, 1896, p. 443; 1898a, p. 1990; 1900, fig. 727; Townsend and Nichols, 1925, p. 14; Andriashev, 1935, p. 114.

Body rather heavy, depressed anteriorly, somewhat compressed posterior to anus; distance from dorsal origin to pelvic base 1.1 (1.0-1.2) in width at pectoral base. Caudal peduncle slender, its depth 1.6 (1.3-1.7) in diameter of orbit.

Head large, 2.6 (2.4-2.7) in standard length, strongly depressed. Lower jaw slightly longer than upper, somewhat protruding; mouth rather large; maxillary reaching to a vertical somewhere between anterior margin and middle of pupil, its length 2.5 (2.2-2.6) in the head. Snout not steep, very gently sloped, rather short, 1.2 (0.9-1.4) in orbit. Nasal spines entirely undeveloped. Anterior nostril in a slender cylindrical tube, its length equal to about 0.5 diameter of pupil, its posterior rim very slightly higher than anterior rim; posterior nostril with scarcely elevated margins, difficult to distinguish from the much-enlarged latero-sensory pores. Pores of infraorbital and mandibular latero-sensory canals equal to about 0.5 diameter of pupil; those of preopercular series even larger. Eye moderate in size; orbit 3.7 (3.5-4.0) in head, its length slightly greater than its height. Upper orbital margin not elevated; interorbital space practically flat, moderately wide, its width equal to about 0.5 diameter of orbit. Occipital region depressed, shallowly concave between the low, rounded fronto-parietal ridges which terminate in short, sharp, semirecumbent, simple or bifid spines. A similar but smaller, blunter, and more erect spine on posttemporal just above upper end of gill opening. Upper preopercular spine rather long, its length exceeding diameter of orbit; lower spines much shorter, but sharply pointed; third one usually directed straight downward; fourth one downward and forward. Opercular flap bluntly rounded, extending about 0.7 of an orbital diameter behind upper end of gill opening.

Lateral line describing a very flat curve, descending from upper edge of supracleithrum to approach axis about at vertical of tip of pectoral fin; the anterior pores double, consisting of a large round opening with a much smaller one slightly dorsal to it; posteriorly the pores single, the dorsal openings not present.

Origin of first dorsal about over tip of opercular flap; base of fin 1.9 (1.7-2.2) in base of second dorsal; fin roughly triangular in shape; spines very slender but covered by thickened membrane; third spine longest, about 1.2 in base of fin. Second dorsal separated from first dorsal by an interspace equal to or somewhat smaller than diameter of orbit, its origin on a vertical about midway between anus and anal origin; fin rather evenly rounded anteriorly, without any distinct angle, posterior end bluntly pointed; fourth, fifth, or sixth ray longest, about 1.5 times length of longest dorsal spine, and 1.6 (1.4-2.0) in base of fin; a number of the middle rays branched; last ray single; terminal membrane attached to peduncle about under basal 0.2 of depressed last ray. Anal origin about under base of second dorsal ray, its last ray under base of next to last dorsal ray; base of fin 1.2 (1.2-1.3) in base of second dorsal; shape of fin similar to that of second dorsal but with membranes rather deeply incised; fourth or fifth ray longest, about equal in length to the longest dorsal ray and 1.4 (1.3-1.5) in base of fin; some of the posterior middle rays slightly branched; last ray simple;

terminal membrane attached to peduncle about under basal 0.2 of depressed last ray. Base of upper pectoral ray slightly in advance of dorsal origin; fin bluntly rounded, extending to a vertical somewhere between first and third anal ray; seventh ray longest; base of fin very broad and strongly procurrent, its width 1.5 (1.5-1.6) in length of longest ray; third to seventh rays branched; lower membranes moderately incised. Pelvic base about midway between tip of lower jaw and anus; fin pointed, extending about 0.5 distance to anus; inner ray the longer; fin adnate to belly by membrane involving basal 0.2 to 0.4 of inner ray. Caudal slightly rounded, large, its length 1.1 (1.0-1.2) times length of anal base.

Measurements in per mille of standard length, based on eight specimens 32.0 to 46.9 mm. (average 37.1 mm.) in standard length: distance from first dorsal to pelvic 226 (205-253); distance from second dorsal to anal 142 (127-151); depth of caudal peduncle 66 (57-75); width at pectoral base 240 (205-269); length of head 389 (358-419); length of maxillary 156 (140-161); length of snout 90 (75-108); diameter of orbit 105 (94-119); distance from snout to first dorsal 375 (358-387); length of first dorsal 158 (136-173); height of first dorsal 129 (117-139); distance from snout to second dorsal 572 (541-618); length of second dorsal 290 (253-353); height of second dorsal 186 (175-195); distance from snout to anal 579 (538-596); length of anal 272 (217-328); height of anal 167 (149-189); distance from snout to pectoral 380 (350-412); width of pectoral base 187 (172-209); length of longest pectoral ray 294 (272-322); distance from snout to pelvic 275 (254-299); length of pelvic 155 (132-183); length of caudal 268 (265-271).

Fin and scale formulae: D. VI(V-VII)—11(10-13); A. 9(8-11); P. 20(19-21); V. I,2(2-3); C. 8; Ll. 16(14-17).

Color of upper parts very light brownish; belly and sides below lateral line dark brown. Fins blackish. Mouth and gill cavity dark.

I have examined specimens of this species from the following localities: Bering Sea off Agattu Island, Lat. 52° 14' 30" N., Long. 174° 13' 00" E.; south of the Pribilof Islands, Lat. 55° 51' 00" N., Long. 169° 18' 00" W.; north of Unalaska Island, Lat. 54° 51' 00" N., Long. 167° 27' 00" W.; Lat. 53° 56' 50" N., Long. 167° 08' 15" W.; off Grays Harbor, Washington, Lat. 46° 55' 00" N., Long. 125° 11' 00" W.; off Point Pinos, California, Lat. 36° 39' 30" N., Long. 122° 09' 00" W.; off Lower California. The known range of this species is from Avatcha Bay, Kamchatka, to Lower California. The bathymetric range is from 399 to 1,083 fathoms.

Genus LEPTOCOTTUS Girard

LEPTOCOTTUS Girard, 1854a, p. 130 (genotype by monotypy *Leptocottus armatus* Girard).

Teeth in narrow bands on vomer and palatines. Three preopercular spines; the upper one long, about 1.5 (1.1-1.8) in orbit, antler like, with a simple or bifid tip and from two to four recurved barbs along its upper margin; second spine short, triangular, sharply pointed; third spine small, largely obscured by skin. Gill membranes broadly joined to isthmus. Gills $3\frac{1}{2}$; a well-developed slit behind the last one, its length about equal to posterior width of maxillary.

No evident scales on head or body. Anus about a pupil diameter in front of anal origin. Anal papilla of males not enlarged.

Pelvic fins I,4.

This genus contains a single species.

LEPTOCOTTUS ARMATUS Girard

(Fig. 38)

LEPTOCOTTUS ARMATUS Girard, 1854a, p. 131 (San Francisco, California); 1854b, p. 145; 1857a, p. 535; 1858b, p. 60, pl. 15, fig. 2; Streets, 1877, p. 44; Lockington, 1880b, p. 26; Jordan and Gilbert, 1881d, p. 455; R. Smith, 1885, p. 46; Jordan, 1887, p. 612; Gilbert, 1895, p. 469; Jordan and Evermann, 1898a, p. 2012; Rutter, 1899, p. 190; Jordan and Evermann, 1900, fig. 733; Evermann and Latimer, 1910, p. 138; Fowler, 1923a, pp. 291, 299; Bonnot, 1932, pp. 15, 16; MacGinitie, 1935, p. 747.
CENTRIDERMICHTHYS ARMATUS Günther, 1860, pp. 171, 523.
LEPTOCOTTUS MACULOSUS Osgood, 1901, p. 20 (*lapsus calami pro Leptocottus armatus*).
LEPTOCOTTUS ARMATUS AUSTRALIS Hubbs, 1921, p. 5 (brackish water lagoon at mouth of Ventura River, Ventura, California); Ulrey and Greeley, 1928, p. 13.
LEPTOCOTTUS ARMATUS ARMATUS Hubbs, 1921, p. 7.

Body robust, subcircular in cross section or somewhat depressed anteriorly; distance from dorsal origin to pelvic base 1.1 (1.0-1.2) in width at pectoral base. Caudal peduncle moderately slender, its depth 1.1 (0.9-1.5) in diameter of orbit.

Head large and depressed, its length 2.6 (2.4-2.8) in standard length. Lower jaw markedly shorter than upper, strongly included. Mouth large; maxillary extending to a vertical somewhere between middle of pupil and posterior margin of orbit or even slightly beyond this point, its length 2.1 (1.9-2.4) in head. Snout not steep, slightly convex in profile, sharply pointed, rather long, its length 1.3 (1.0-1.9) times diameter of orbit. No external trace of nasal spines. Anterior nostrils in short cylindrical tubes, their posterior rims produced into valvular flaps; posterior nostrils simple holes, not at all tubular. Eye small, decreasing in proportional size with advancing age; orbit 5.2 (3.7-6.3) in head, markedly longer than high; upper orbital margins not elevated. Interorbital space flat and very broad in old individuals, much narrower and channeled by a shallow groove in young specimens; its width 3.0 or 4.0 in diameter of orbit in 40-mm. juveniles, about equal to diameter of orbit in specimens 120 mm. in standard length, and even wider in very large specimens. Top of head gently and evenly rounded, the frontoparietal ridges inconspicuous or indistinguishable except in young. No spines on top of head. Opercular flap extending more than an orbital diameter behind upper end of gill opening in very large specimens, about half this distance in young ones, its tip bluntly pointed. The skin on the dorsal surfaces of head, perfectly smooth in small specimens, becomes finely granular later on and in large individuals it is strongly rugose.

Lateral line forming an extremely flat curve or almost straight line from its origin to its end. No cirri on head or body.

Origin of first dorsal about over or somewhat behind end of opercular flap; base of fin 2.2 (1.8-2.7) in base of second dorsal; fin contour strongly rounded, almost semicircular; second, third, or fourth spine longest, 1.2 (0.9-1.5) in base of fin. Second dorsal contiguous to first dorsal or separated from it by a very narrow interspace; fin broadly rounded anteriorly, truncated posteriorly, main portion of the distal profile almost straight and somewhat higher anteriorly than posteriorly; longest ray, somewhere between third and eighth, equal to or somewhat longer than longest dorsal spine and 2.2 (1.8-2.6) in base of fin; terminal membrane attached to peduncle under basal 0.8 or more of depressed last ray, often

extending well beyond its tip. Anal origin under third to fifth dorsal ray, its posterior end about under last ray of second dorsal; base of fin 1.2 (1.0-1.3) in base of second dorsal; fin similar in shape to second dorsal; longest ray, somewhere between fourth and eighth, about equal to or somewhat shorter than longest dorsal spine and 2.4 (2.1-2.8) in base of fin; terminal membrane attached to peduncle under basal 0.8 or more of depressed last ray, often extending well beyond its tip. Base of the upper pectoral ray directly under or somewhat anterior to dorsal origin; fin bluntly rounded, extending to a vertical somewhere between first and fourth anal ray; fourth, fifth, or sixth ray longest; base of fin strongly procurrent, broad, its width 2.1 (1.7-2.4) in longest ray; lower membranes slightly incised. Pelvic base midway between snout and a point somewhere between anus and base of third anal ray; fin extending about half way to the same point, its length 1.1 (0.7-1.2) times width of pectoral base; second ray longest, third ray often subequal to it, fourth ray shortest and attached to belly by membrane involving about 0.3 of the ray. Caudal truncate or slightly rounded, of moderate size, its length 1.5 (1.3-1.8) in length of anal base.

Measurements in per mille of standard length, based on 50 specimens 22.3 to 185.9 mm. (average 120.3 mm.) in standard length: distance from first dorsal to pelvic 210 (176-239); distance from second dorsal to anal 169 (152-192); depth of caudal peduncle 68 (61-75); width at pectoral base 226 (195-269); length of head 383 (362-415); length of maxillary 183 (157-208); length of snout 101 (90-127); diameter of orbit 76 (62-99); distance from snout to first dorsal 376 (358-405); length of first dorsal 147 (112-178); height of first dorsal 126 (107-146); distance from snout to second dorsal 557 (520-585); length of second dorsal 320 (297-351); height of second dorsal 143 (117-167); distance from snout to anal 603 (566-657); length of anal 274 (246-296); height of anal 113 (96-127); distance from snout to pectoral 370 (350-408); width of pectoral base 133 (119-157); length of longest pectoral ray 271 (244-320); distance from snout to pelvic 307 (258-369); length of pelvic 142 (108-167); length of caudal 182 (159-212).

Fin and scale formulae: D. VII(VI-VIII)—17(15-20); A. 17(15-20); P. 19 (17-20); V. I,4; C. 9(8-10); Ll. 39(37-42)+1(1-3).

General dorsal ground color a mottled olive gray, green, or brown; this merging into a brassy tinge at level of lateral line, which is, in turn, bordered ventrally by bright yellow. Lower jaw, posterior part of upper jaw, gill membranes, and all ventral surfaces of body pearly white. First dorsal gray or greenish, with a horizontal light streak near its base, and a black spot distally between the last two or three rays. Second dorsal and caudal evenly barred with gray or green, the caudal with brassy reflections distally. Pectorals barred with deep yellow and black dorsally. Anal and pelvics colorless, or anal sometimes tinged with yellow on posterior distal portion.

I have examined specimens of this species from Karluk, Alaska; Olive Cove, Etolin Island, Alaska; San Juan Islands and Puget Sound, Washington; and from the following localities in California: Crescent City, Lat. 41° 44' 42" N., Long. 124° 11' 54" W.; Trinidad Head; Eureka, Lat. 40° 48' 18" N., Long. 124° 10' 25" W.; off Point Reyes, Lat. 38° 01' 00" N., Long. 123° 09' 00" W.; off Rocky Point, Lat. 37° 51' 30" N., Long. 122° 38' 00" W.; Bolinas Lagoon, Lat. 37° 54' 36" N., Long. 122° 40' 53" W.; Berkeley fishing pier; San Francisco Bay at Palo Alto; pier at north end of Van Ness Avenue, San Francisco, Lat. 37° 48' 23" N., Long. 122° 25' 34" W.; Santa Cruz; Elkhorn Slough, Lat. 36° 48' 55" N., Long. 121° 47' 12" W.; Monterey markets; Santa Ynez River, near Surf, Lat. 34° 41' 25" N., Long. 120° 36' 02" W.; Newport Bay; San Diego; north side of San Martin Island, Lower California; San Quintin Bay, Lower California. The first and last of these locality records repre-

sent the known limits of the range of this species. It is a shallow-water form which is common in bays and often enters brackish or possibly even fresh water. Large specimens have been taken in depths of as much as 50 fathoms.

Genus BLEPSIAS Cuvier

BLEPSIAS Cuvier, 1829, p. 167 (genotype by monctypy *Trachinus cirrhosus* Pallas); Schmidt, 1929b, p. 394.
PEROPUS Lay and Bennett, 1839, p. 59 (genotype by monotypy *Blepsias bilobus* Cuvier and Valenciennes).
HISTIOCOTTUS Gill, 1889, p. 573 (substitute for *Peropus* Lay and Bennett, preoccupied in herpetology).

Teeth in a small triangular or crescent-shaped patch on vomer and in elongated oval bands on palatines. Two well-defined, coarse, and simple preopercular spines, the lower one the larger, its length about equal to diameter of pupil; lower preopercular margin with two rounded lobes, the remnants of additional obsolescent spines. Gill membranes broadly united, free from isthmus. Gills $3\frac{1}{2}$; a well-developed slit behind the last one, its length equal to about 0.7 diameter of the pupil.

Lateral line armed with small deeply embedded scales. Almost all of the body covered by minute embedded scales, each with a single spine which extends outward and is covered by skin, so that the body appears to be granulated with small dermal papillae. Anus advanced about 0.3 of the distance between anal origin and pelvic base in very small specimens, migrating anteriorly with advancing age and lying close behind pelvics in large adults. Anal papilla not enlarged in males.

Pelvics I,3.

This north Pacific genus contains two or possibly three species, only one of which occurs in the waters of California.

BLEPSIAS CIRRHOSUS (Pallas)

(Fig. 39)

TRACHINUS CIRRHOSUS Pallas, 1811, p. 237 (Avatcha Bay, Kamchatka, and Gulf of Penshin, Okhotsk Sea).
BLEPSIAS CIRRHOSUS Cuvier, 1829, p. 167; Jordan and Gilbert, 1881c, p. 455; Jordan and Evermann, 1898a, p. 2016; 1900, figs. 737-737b.
BLEPSIAS TRILOBUS Cuvier and Valenciennes, 1829, p. 375 (the same types).
BLEPSIAS DRACISCUS Jordan and Starks, 1904, p. 322, fig. 40 (Aomori, Japan).
BLEPSIAS CIRRHOSUS f. TYPICA Schmidt, 1929b, p. 397.
BLEPSIAS CIRRHOSUS DRACISCUS Schmidt, 1929b, p. 397.

Body rather deep and increasing in depth with advancing age; distance from dorsal origin to pelvic base 3.8 (3.3-4.3) in standard length; strongly compressed, particularly posteriorly; width at pectoral base 1.8 (1.5-2.2) in distance from dorsal origin to pelvic base. Caudal peduncle slender, its depth 1.6 (1.2-2.1) in diameter of orbit.

Head short 3.3 (3.0-3.7) in standard length. Lower jaw about equal to or very slightly shorter than upper jaw, barely included. Mouth moderate in size; maxillary extending to a vertical somewhere under pupil, its length 2.3 (2.0-2.7)

in head. Snout not steep, rather short, its length 1.1 (0.9-1.4) in orbit. Nasal spines strong, sharp, about in line with profile of snout. Anterior nostril in a long cylindrical tube, its length about equal to or somewhat greater than 0.5 diameter of pupil, without valvular flaps; posterior nostril opening immediately behind the tip of a conical tube which is about half as long as that of anterior nostril, located near upper anterior orbital margin, almost exactly similar to openings of adjacent latero-sensory pores. Eye rather small, proportionately larger in small individuals than in large ones; orbit 3.3 (2.9-4.1) in head, practically round. Upper orbital margins markedly elevated. Interorbital space very wide, about equal to diameter of orbit, grooved, with two low longitudinal ridges extending through the trough and diverging somewhat posteriorly; a less clearly defined median ridge and a similar transverse one between the posterior ends of the lateral ridges in large specimens but these often not discernable in very young individuals. Top of head transversely concave between the short and heavy fronto-parietal ridges which are contiguous to similar heavy ridges extending backward and downward along upper margin of posttemporal; a similar pterotic ridge extending backward from upper posterior rim of orbit, and another less well-developed one behind it on supracleithrum. Opercular flap ending in a blunt point extending about a pupil diameter below and slightly behind upper end of gill opening.

Lateral line descending from upper end of gill opening in a gentle curve to merge into a barely perceptible arch opposite distal part of pectoral fin, and then extending in an almost straight line along the body axis to caudal base. Usually two streaks of scales extend downward and backward from eye, one just behind tip of maxillary, the other immediately below suborbital stay; this latter one often reduced to a few scales and sometimes entirely missing; a small patch of scales on base of opercle, and a well-defined V-shaped patch on chin. No scales on caudal peduncle; from this bare area a naked streak of varying length extends forward along the lateral line, usually to about the vertical of the tip of the pectoral fin, while a series of from one to three naked areas, subcircular or elongated oval in shape and increasing in size anteriorly, extend below the lateral line between this point and the axilla. Short naked areas extend along the posterior part of the second dorsal and anal fins, but, anteriorly, small obliquely linear patches of scales extend onto the base of each ray and often far up on some of the anterior spines of the first dorsal. In specimens about 20 mm. in standard length the scales are limited to those of the lateral line, a small patch on the breast, and four narrow longitudinal streaks, each a single scale in width. One band of scales extends slightly below the base of the dorsal fins from origin of the first dorsal not quite to end of second dorsal; another band extends slightly above anal base from anus to end of fin; the other two rows are formed by more widely scattered scales and extend over the middle of the anal fin midway between the two primary rows and the lateral line. From these initial centers of squamation the scales spread over the body. In some 40-mm. specimens the axillary naked area is still continuous through the posterior patches of the series with the naked area along the lateral line, extensive naked streaks occur immediately above the lateral line anteriorly, and smaller ones may still be present posteriorly; in other specimens of the same size the squamation approaches that of the adult. Only very rarely, and evidently as an abnormality, do naked areas appear anteriorly above the lateral line in adults. A long slender cirrus on preorbital margin directly in front of each nasal spine; a similar one on median line of snout about on level of base of nasal spines, and a series of three similar cirri along dentary just below lower margin of lower lip. No other well-developed cirri on head or body, but many of the latero-sensory pores on top and sides of head open through fleshy tubes similar in appearance to short heavy cirri.

Origin of first dorsal about over longest preopercular spine, well in advance of upper end of gill opening; base 3.2 (2.6-4.1) in second dorsal base and 2.6 (2.1-3.2) in anal base; first two spines with approximated bases; first, second or third spine longest, 1.3 (0.8-1.7) in base of fin; fourth or fifth spine abruptly shorter than preceding spine and usually shorter than succeeding one, the fin deeply notched at this point. Second dorsal contiguous to first dorsal or separated from it by a narrow interspace no wider than diameter of pupil; fin contour broadly rounded, the profile higher and more abruptly rounded posteriorly than anteriorly; longest ray, somewhere between eighth and fifteenth, somewhat longer than longest dorsal spine and 2.0 (1.8-2.4) in base of fin; membrane between the anterior rays deeply incised; terminal membrane attached to peduncle under basal 0.6 to 0.9 of depressed last ray. Anal origin under third to fifth dorsal ray, its posterior end under second to fourth ray from end of second dorsal; base of fin 1.3 (1.1-1.5) in base of second dorsal; fin contour similar to that of second dorsal but somewhat lower; longest ray, somewhere between eleventh and fourteenth, approximately equal to longest dorsal spine and 1.9 (1.6-2.3) in base of fin; terminal membrane attached to peduncle under basal 0.5 to 0.7 of depressed last ray. Base of upper pectoral ray under third to fifth dorsal spine; fin bluntly rounded, extending to a vertical somewhere between third and eighth anal ray; fifth, sixth or seventh ray longest; base of fin slightly procurrent, rather narrow, 4.1 (3.4-4.8) in longest ray; only the lower three or four membranes deeply incised. Pelvic base on a vertical somewhere between fourth and sixth dorsal spine; fin short, extending from 0.3 to 0.6 of the distance to anal origin, reaching well beyond anus in large adults, falling far short of reaching it in small specimens; length of fin 1.4 (0.9-1.8) in width of pectoral base; middle ray longest, inner ray usually, but not always, shortest; inner ray adante to belly by membrane involving about 0.5 of the ray. Caudal fin truncate or slightly rounded, its length 1.4 (1.2-1.7) in anal base. No branched rays in any of the fins, not even in the caudal.

Measurements in per mille of standard length, based on 50 specimens 32.7 to 122.8 mm. (average 63.9 mm.) in standard length: distance from first dorsal to pelvic 264 (234-295); distance from second dorsal to anal 277 (243-314); depth of caudal peduncle 55 (49-64); width at pectoral base 148 (123-190); length of head 300 (267-330); length of maxillary 133 (103-150); length of snout 77 (63-90); diameter of orbit 90 (77-105); distance from snout to first dorsal 251 (230-278); length of first dorsal 158 (120-197); height of first dorsal 206 (174-236); distance from snout to second dorsal 432 (401-461); length of second dorsal 508 (460-557); height of second dorsal 251 (191-275); distance from snout to anal 513 (480-554); length of anal 402 (346-446); height of anal 207 (181-235); distance from snout to pectoral 289 (248-319); width of pectoral base 86 (68-97); length of the longest pectoral ray 354 (296-389); distance from snout to pelvic 318 (278-373); length of pelvic 117 (86-148); length of caudal 289 (260-312).

Fin and scale formulae: D. VIII(VII-IX)—23(22-25); A. 19(18-21); P. 12 (11-12); V. I,3; C. 0(but with 7-9 full-length rays); Ll. 51(43-57)+2(1-3).

General ground color olive green; back marked by four to six black bars with paler margins; naked patches of sides white or brassy; black bands radiating from eye. Dorsal and caudal fins translucent, barred and blotched with blackish; anal yellowish; pelvics colorless.

The present description is based on specimens from Unalaska, and Captain's Harbor, Unalaska Island, Alaska, and from Puget Sound, Port Angeles, and Port Ludlow, Washington. I have also examined 29 cotypes of *Blepsias draciscus* from Hakodate and Iturup Island, Japan. These differ from the American material in extent of squamation, the somewhat smaller size of individual scales, the increased number

of pectoral rays (13-14 instead of 11-12), and, usually, in the possession of a supraorbital cirrus. However, Schmidt, 1929b, noting the great variation among individuals from the same region in regard to scales and cirri, has considered the two forms to be only subspecies of a single widespread species. I follow Schmidt, particularly since the only material available to me from an intermediate locality is a collection of 20 very small specimens from Petropavlovsk, Kamchatka, which are too immature to yield any very definite information on scales and cirri, and which are intermediate as to the number of pectoral rays (12-13). The final decision as to the specific or subspecific status of the two forms must await careful study of abundant adult material from the western Aleutians, the Komandorski Islands, southern Kamchatka, and the northern Kuriles. It may be noted that if the two forms should finally be found to be specifically distinct, the name *B. cirrhosus* may have to be applied to the Asiatic species and the American species given a new name. The species, as considered in the present paper, occurs in the intertidal region and shallow water from Aomori, Japan, through the Aleutian Islands to San Francisco, California. It is rare in California.

Genus NAUTICHTHYS Girard

NAUTICHTHYS Girard, 1858b, p. 74 (genotype by monotypy *Blepsias oculo-fasciatus* Girard); Schmidt, 1929b, p. 396.

Teeth present on vomer and palatines. Three or four short, heavy, simple, preopercular spines; the upper two usually distinct and diverging from each other, rarely more or less fused; the lower spines frequently nothing more than slight angular expanses of the preopercular margin. Gill membranes broadly attached to the isthmus. Gills $3\frac{1}{2}$; a small slit behind the last one, its length less than 0.5 diameter of pupil.

Head and body almost entirely covered by minute embedded scales, each armed with a single spine which is covered by skin so that the body appears to be granulated with small dermal papillae; scales of lateral line somewhat enlarged. Anus advanced about 0.3 of the distance between anal origin and pelvic base in small specimens, lying about midway between these points in large adults.

Pelvics I,3.

This genus is usually considered to be monotypic. It is, however, probable that the more northern *Nautiscus pribilovius* (Jordan and Gilbert) should also be included in it.

NAUTICHTHYS OCULO-FASCIATUS (Girard)

(Fig. 40)

BLEPSIAS OCULO-FASCIATUS Girard, 1858a, p. 202 (Fort Steilacoom, Washington).
NAUTICHTHYS OCULO-FASCIATUS Girard, 1858b, p. 75; Steindachner, 1877, p. 130, pl. 14, figs. 1, 1a.
NAUTICHTHYS OCULOFASCIATUS Jordan and Gilbert, 1881d, p. 455; H. M. Smith, 1895, p. 288; Jordan and Evermann, 1898a, p. 2021.

Body moderately slender, its depth increasing somewhat with age, markedly compressed, particularly posteriorly; width at the pectoral base 1.4 (1.3-1.6) in distance from dorsal origin to pelvic base. The caudal peduncle rather heavy, its depth 1.3 (1.1-1.6) in orbit.

Head short, 3.1 (2.8-3.4) in standard length. Lower jaw somewhat shorter than upper, slightly included. Mouth moderate in size; maxillary extending to a vertical somewhere under pupil, its length 2.5 (2.3-2.6) in head. Snout steep, moderately long, its length 1.2 (0.9-1.4) in orbit. Nasal spines strong, sharp, about in line with profile of snout. Both nostrils in small cylindrical tubes, strongly constricted distally and without any flap-like valvular extensions of the rim; the posterior tube markedly smaller than the anterior one. Eye of moderate size, proportionally larger in young individuals than in old ones; orbit 3.2 (2.9-3.5) in head, usually slightly elongated but often almost round. Upper orbital margin strongly elevated; interorbital space very deeply grooved, rather broad, its width always markedly greater than posterior width of maxillary, often twice as wide in small specimens. Top of head marked by a pronounced depression; this is very abruptly bordered posteriorly by the dorsal origin which rises vertically, or even protrudes somewhat over the depression. Fronto-parietal ridges bearing two heavy, coarse, laterally compressed spines; three or four similar heavy spines in a series along upper posterior orbital margin in adults, the posterior spines progressively smaller; only the largest supraorbital spine developed in small individuals; a short bony ridge or semirecumbent spine on posttemporal immediately above and in advance of upper end of gill opening. Opercular flap extending from 0.3 to 0.5 of an orbital diameter below and behind upper end of gill opening, its tip bluntly pointed.

Lateral line extending in a very gentle sigmoid curve from just behind posttemporal spine to base of caudal. Most of the dorsal surfaces of head above level of suborbital stay densely scaled, some scales even on upper part of eyeball, but median line of interorbital space largely naked. A small naked area at origin of first dorsal, another just in front of pelvics, a larger one in the axilla, and a long narrow naked streak from anus along anal base and continued posteriorly on ventral surface of caudal peduncle. Usually a small simple cirrus on median surface of nasal spine. Posterior border of maxillary bearing a large, flat, and often fimbriated cirrus and usually one or two small simple cirri above it; usually about four minute cirri scattered along lower suborbital margin. A very large, flat, fringed cirrus on dorsal part of eyeball and from one to four smaller simple cirri in series behind it. Usually a well-developed cirrus on tip of major postorbital spine and one just posterior to its base; often similar but smaller cirri on fronto-parietal and posttemporal spines and on the latero-sensory pore margin directly behind the fronto-parietal spines. In young specimens it is often impossible to detect any trace of several of these cirri, but the large orbital and maxillary cirri are always in evidence. Anus near tip of a short fleshy tube. In females this tube may be as long as posterior width of maxillary and on its posterior surface it bears a minute genital papilla; the anal tube bordered laterally and posteriorly by a crescentic fold of fleshy tissue. In males the anal tube is shorter; the genital papilla is based well behind the anus, often as close to anal origin as to anal tube, and is modified into a long and very slender penis the length of which, in adults, may equal 0.8 diameter of orbit; anal tube and penis entirely surrounded by a fold of fleshy tissue in the form of an elongated oval. Typical development of these structures is not to be found in specimens less than 50 mm. in standard length.

Origin of first dorsal at vertical of fronto-parietal spines and far in front of upper end of gill opening; base of fin 3.8 (3.3-4.7) in base of second dorsal and 2.5 (2.3-3.0) in base of anal; first two spines with approximate bases; the fin extremely high, bluntly pointed or rounded, its posterior margin markedly convex; second or third spine longest, its length equal to or greater than length

of head and 2.8 (2.5-3.4) times base of fin; usually an irregular fringe of membrane extends along anterior edge of first spine. Second dorsal usually separated from first dorsal by a very narrow interspace, often contiguous to it, sometimes with membrane from last spine definitely attached to basal portion of first ray; fin with a well-developed anterior angle, truncate posteriorly, the distal profile almost straight and somewhat higher posteriorly than anteriorly; longest ray, somewhere between seventeenth and twentieth, not more than 0.5 as long as the longest dorsal spine and 2.7 (2.2-3.0) in base of fin; terminal membrane attached to peduncle under basal 0.6 to 0.8 of depressed last ray. Anal origin under sixth to ninth dorsal ray, its posterior end under third to fifth ray from end of second dorsal; base of fin 1.5 (1.4-1.6) in base of second dorsal; fin contour similar to that of second dorsal but much lower; longest ray, somewhere between thirteenth and nineteenth, 2.2 (2.0-2.7) in base of fin; terminal membrane attached to peduncle under basal 0.2 or 0.3 of depressed last ray. Base of upper pectoral ray on a vertical somewhere between fifth and eighth dorsal spine; fin bluntly pointed, extending to a vertical somewhere between third and eighth anal ray; sixth or seventh ray longest; base of fin moderately broad, 2.9 (2.6-3.5) in longest ray; lower membranes deeply incised. Pelvic base midway between snout and a point somewhere between the fourth and seventh anal ray; fin extending to somewhere between anus and anal origin, its length 1.7 (1.4-2.0) times width of pectoral base; middle ray longest, outer ray shortest; inner ray slightly adnate to belly by membrane involving about 0.1 of the ray. Caudal with the upper rays markedly shorter than the lower rays, its posterior margin obliquely rounded and ending in a blunt point ventrally; fin rather short, its length 1.6 (1.4-1.8) in anal base. Most of the dorsal rays, some of the anal rays, and three or four rays in the upper part of the pectoral are branched in adults; in young specimens there are no branched rays in any of the fins, except those of the caudal and the last ray of the anal which is always split to the base and counted as $1\frac{1}{2}$.

Measurements in per mille of standard length, based on 15 specimens 32.6 to 134.6 mm. (average 69.1 mm.) in standard length: distance from first dorsal to pelvic 264 (241-301); distance from second dorsal to anal 267 (229-300); depth of caudal peduncle 75 (69-80); width at pectoral base 185 (173-204); length of head 322 (292-355); length of maxillary 131 (111-149); length of snout 90 (78-104); diameter of orbit 102 (85-120); distance from snout to first dorsal 268 (231-304); length of first dorsal 151 (128-176); height of first dorsal 427 (350-541); distance from snout to second dorsal 406 (365-434); length of second dorsal 578 (540-654); height of second dorsal 219 (206-245); distance from snout to anal 512 (484-560); length of anal 384 (349-409); height of anal 172 (146-185); distance from snout to pectoral 320 (284-352); width of pectoral base 119 (109-141); length of longest pectoral ray 353 (305-406); distance from snout to pelvic 300 (267-343); length of pelvic 202 (162-219); length of caudal 247 (230-267).

Fin and scale formulae: D. IX(VIII-IX)—28(27-29); A. $19\frac{1}{2}(18\frac{1}{2}$-$19\frac{1}{2})$; P. 14 (13-14); V. I,3; C. 10(9-11); Ll. 43(41-45)+1(1-2).

Color grayish above; sides with dark marblings and obscure dusky bands; a very conspicuous black band through eye and across cheek. First dorsal blackish; other fins barred with light and dark, except the pelvics which are plain.

I have examined specimens of this species from the San Juan Islands, and from Puget Sound, Washington, and from Monterey Bay, California. The species ranges from about Sitka, Alaska, to Monterey Bay, California. The exact northern limit of its range is not known with certainty, since it has been confused with *Nautiscus pribilovius*. It has been taken intertidally and to depths of at least 25 fathoms. Although common in Puget Sound this fish is rarely taken in California.

LITERATURE CITED

ANDRIASHEV, Anatoly P.
1935 New data on deep-water fishes of the Bering Sea. Comptes Rendus (Doklady) Acad. Sci. URSS [Akademiîa nauk SSSR], Leningrad, vol. 4 (9), pp. 113-116, fig.

AYRES, William O.
1854a [Descriptions of species of fish, believed to be new.] Proc. California Acad. Nat. Sci., San Francisco, vol. 1, pp. 3-4.
1854b [A new species of fish, the CLYPEOCOTTUS ROBUSTUS.] Ibid., vol. 1, pp. 11-12.
1855 [A communication to attempt a correct exposition of the two species of the genus HEMILEPIDOTUS.] Ibid., vol. 1, pp. 75-77.

BARNHART, Percy Spencer
1936 Marine Fishes of Southern California. 209 pp., 290 figs. Berkeley, California.

BEAN, Barton Appler, and WEED, Alfred Cleveland.
1920 Notes on a collection of fishes from Vancouver Island, B.C. Trans. Roy. Soc. Canada, Ottawa, ser. 3, vol. 13, pp. 69-83, 4 pls.

BEAN, Tarleton Hoffman
1882a A preliminary catalogue of the fishes of Alaskan and adjacent waters. Proc. U.S. Nat. Mus., vol. 4, pp. 239-272.
1882b Notes on a collection of fishes made by Captain Henry E. Nichols, U.S.N., in British Columbia and southern Alaska, with descriptions of new species and a new genus (DELOLEPIS). Ibid., vol. 4, pp. 463-474.

BLEEKER, Pieter
1859 Enumeratio specierum piscium hucusque in Archipelago Indico observatarum..... Acta Soc. Sci. Indo-Neerl., Batavia, vol. 6, xxxvi+276 pp.

BOLIN, Rolf Ling
1936 A revision of the genus ICELINUS Jordan. Copeia, 1936, no. 3, pp. 151-159, fig.
1937 Notes on California fishes. Ibid., 1937, no. 1, pp. 63-64.

BONNOT, Paul
1932 The California shrimp industry. Fish Bull. 38, California Division Fish & Game, Sacramento, 20 pp., 11 figs.

CLARK, George Houghton
1935 San Francisco trawl fishery. California Fish and Game, Sacramento, vol. 21, pp. 22-37, figs. 9-16.

CLARK, Howard Walton
1936 New and noteworthy fishes. Proc. California Acad. Sci., San Francisco, ser. 4, vol. 21, pp. 383-396.

CUVIER, Georges Léopold Chrétien Frédéric Dagobert
1829 La Règne Animal... 2 ed., vol. 2, 532 pp. Paris.

CUVIER, Georges, and VALENCIENNES, Achille
1829 Histoire Naturelle des Poissons. Vol. 4, xxvi+2+518 pp. Paris.

EIGENMANN, Carl H.
1893 The fishes of San Diego, California. Proc. U.S. Nat. Mus., vol. 15, pp. 123-178, pls. 10-18.

EIGENMANN, Carl H., and EIGENMANN, Rosa Smith
1889a Contributions from the San Diego Biological Laboratory. I. West American Scientist, San Diego, California, vol. 6, pp. 44-47.
1889b The fishes of Cortez Banks. Ibid., vol. 6, pp. 123-131.
1892 A catalogue of the fishes of the Pacific Coast of America north of Cerros Island. Ann. New York Acad. Sci., vol. 6, pp. 349-358.

EIGENMANN, Rosa Smith
1890 Note on TYPHLOGOBIUS CALIFORNIENSIS. Zoe, San Francisco, vol. 1, pp. 181-182.

ESCHSCHOLTZ, Johan Friedrich von
1829 Zoologischer Atlas, enthaltend Abbildungen und beschreibungen neuer Thierarten.... Heft 3, 18 pp., pls. 11-15. Berlin.

EVERMANN, Barton Warren
1930 Report of the director of the museum and of the aquarium for the year 1929. Proc. California Acad. Sci., San Francisco, ser. 4, vol. 18, pp. 542-579.

EVERMANN, Barton Warren, and GOLDSBOROUGH, Edmund Lee
1907 The fishes of Alaska. Bull. U.S. Bur. Fish., vol. 26, pp. 219-360, 268 figs., pls. 14-42.

EVERMANN, Barton Warren, and LATIMER, Homer Barker
1910 On a collection of fishes from the Olympic Peninsula, together with notes on other West Coast species. Proc. Biol. Soc. Washington, vol. 23, pp. 131-139.
FITZINGER, Leopold Joseph
1873 Versuch einer natürlichen Classification der Fische. Sitzb. k. Akad. Wissensch., Wien, math.-nat. Classe, vol. 67, pp. 5-58.
FOWLER, Henry Weed
1923a Records of West Coast fishes. Proc. Acad. Nat. Sci. Philadelphia, vol. 75, pp. 279-301.
1923b Fishes in the Long Beach (California) Aquarium. Copeia, no. 120, pp. 78-79.
GILBERT, Charles Henry
1891 A preliminary report on the fishes collected by the steamer Albatross on the Pacific Coast of North America during the year 1889, with descriptions of twelve new genera and ninety-two new species. Proc. U.S. Nat. Mus., vol. 13, pp. 49-126.
1895 The ichthyological collections of the steamer Albatross during the years 1890 and 1891. Rept. U.S. Comm. Fish., part 19, pp. 393-476, pls. 20-35.
1899 Report on fishes obtained by the steamer Albatross in the vicinity of Santa Catalina Island and Monterey Bay. Ibid., part 24, pp. 25-29, pls. 1-2.
1914 Two cottoid fishes from Monterey Bay, California. Proc. U.S. Nat. Mus., vol. 47, pp. 135-137, pl. 11.
1915 Fishes collected by the United States Fisheries steamer "Albatross" in Southern California in 1904. Ibid., vol. 48, pp. 305-380, pls. 14-22.
GILBERT, Charles Henry, and BURKE, Charles Victor
1912 Fishes from Bering Sea and Kamchatka. Bull. U.S. Bur. Fish., vol. 30, pp. 31-96, 37 figs.
GILBERT, Charles Henry, and THOMPSON, Joseph C.
1905 Notes on the fishes of Puget Sound. Proc. U.S. Nat. Mus., vol. 28, pp. 973-987, 3 figs.
GILL, Theodore Nicholas
1860 Description of new generic types of cottoids, from the collection of the North Pacific Exploring Expedition under Com. John Rodgers. Proc. Acad. Nat. Sci. Philadelphia, 1859 (1860), pp. 165-166.
1862a Notes on some genera of fishes of the western coast of North America. Ibid., 1861 (1862), pp. 164-168.
1862b Synopsis of the notothenioids. Ibid., 1861 (1862), pp. 512-522.
1863a Notice of a new species of HEMILEPIDOTUS, and remarks on the group (Temnistiae) of which it is a member. Ibid., 1862 (1863), pp. 13-14.
1863b Notice of a collection of the fishes of California presented to the Smithsonian Institution by Mr. Samuel Hubbard. Ibid., 1862 (1863), pp. 274-282.
1889 On the classification of the mail-cheeked fishes. Proc. U.S. Nat. Mus., vol. 11, pp. 567-592.
GIRARD, Charles Frédéric
1854a Descriptions of new fishes collected by Dr. A. L. Heerman, naturalist attached to the survey of the Pacific railroad route, under Lieut. R. S. Williamson, U.S.A. Proc. Acad. Nat. Sci. Philadelphia, vol. 7, pp. 129-140.
1854b Observations upon a collection of fishes made on the Pacific Coast of the United States, by Lieut. W. P. Trowbridge, U.S.A., for the museum of the Smithsonian Institution. Ibid., vol. 7, pp. 142-156.
1856 Contributions to the ichthyology of the western coast of the United States, from specimens in the museum of the Smithsonion Institution. Ibid., vol. 8, pp. 131-137.
1857a A list of the fishes collected in California, by Mr. E. Samuels, with descriptions of the new species. Boston Journ. Nat. Hist., vol. 6, pp. 533-544, pls. 24-26.
1857b Report upon fishes collected on the survey. [In] Report upon routes in California and Oregon explored by Lieut. R. S. Williamson, Corps of Topographical Engineers, and Lieut. Henry L. Abbot, Corps of Topographical Engineers, in 1855. U.S. Senate Miscell. Doc. no. 78, 33 Congr., 2 Sess., no. 1, pp. 9-34, 11. pls.
1858a Notice upon new genera and new species of marine and fresh-water fishes from western North America. Proc. Acad. Nat. Sci. Philadelphia, vol. 9, pp. 200-202.
1858b Fishes. [In] General report upon the zoology of the several Pacific railroad routes. U.S. Senate Miscell. Doc. no. 78, 33 Congr., 2 Sess., xiv+400 pp., 27 pls.
GREELEY, Arthur White
1899 Notes on the tide-pool fishes of California, with a description of four new species. Bull. U.S. Fish Comm., vol. 19, pp. 7-20, 5 figs.

GÜNTHER, Albert Carl Ludwig Gotthilf
1860 Catalogue of the Acanthopterygian Fishes in the Collection of the British Museum. Vol. 2, xxi+548 pp. London.

HEWATT, Willis G.
1938 Notes on the breeding seasons of the rocky beach fauna of Monterey Bay, California. Proc. California Acad. Sci., San Francisco, ser. 4, vol. 23, pp. 283-288.

HUBBS, Carl Leavitt
1921 The latitudinal variation in the number of vertical fin-rays in LEPTOCOTTUS ARMATUS. Occas. Papers Mus. Zool., Univ. Michigan, Ann Arbor, no. 94, 7 pp., map.
1926a Descriptions of new genera of cottoid fishes related to ARTEDIUS. Ibid., no. 170, 16 pp.
1926b A revision of the fishes of the subfamily Oligocottinae. Ibid., no. 171, 18 pp.
1928 A check list of the marine fishes of Oregon and Washington. Journ. Pan-Pacific Research Institute, Honolulu, vol. 3, no. 3, pp. 9-16.

HUBBS, Carl Leavitt, and SCHULTZ, Leonard Peter
1941 Contribution to the ichthyology of Alaska, with descriptions of two new fishes. Occas. Papers Mus. Zool., Univ. Michigan, Ann Arbor, no. 431, 31 pp.

JORDAN, David Starr
1885 A catalogue of the fishes known to inhabit the waters of North America, north of the Tropic of Cancer, with notes on the species discovered in 1883 and 1884. Rept. U.S. Comm. Fish., part 13, separate, pp. 1-185 (the same work in the bound volume, issued in 1887, is paginated 789-973).
1887 The fisheries of the Pacific Coast. [In] The Fisheries and Fishery Industries of the United States. Edited by George Brown Goode. Sect. 2, pp. 589-630. Washington.
1896 Notes on fishes, little known or new to science. Proc. California Acad. Sci., San Francisco, ser. 2, vol. 6, pp. 201-244, pls. 20-43.
1919 The genera of fishes.... Leland Stanford Junior Univ. Publs., California, Univ. ser., part 2, pp. i-ix+163-284+i-xiii.
1920 The genera of fishes.... Ibid., part 4, pp. 415-576.

JORDAN, David Starr, and EVERMANN, Barton Warren
1896 A check-list of the fishes and fish-like vertebrates of North and Middle America. Rept. U.S. Comm. Fish., part 21, pp. 207-584.
1898a The fishes of North and Middle America.... Part II. Bull. U.S. Nat. Mus., no. 47, part 2, pp. i-xxx+1241-2183.
1898b The fishes of North and Middle America.... Part III. Ibid., no. 47, part 3, pp. i-xxv+2183a-3136.
1900 The fishes of North and Middle America.... Part IV. Ibid., no. 47, part 4, pp. i-ci+3137-3313, 958 figs.

JORDAN, David Starr, EVERMANN, Barton Warren, and CLARK, Howard Walton
1930 Check list of the fishes and fishlike vertebrates of North and Middle America north of the northern boundary of Venezuela and Colombia. Rept. U.S. Comm. Fish., part 2, 1928 (1930), 670 pp.

JORDAN, David Starr, and GILBERT, Charles Henry
1881a Notes on a collection of fishes from San Diego, California. Proc. U.S. Nat. Mus., vol. 3, pp. 23-34.
1881b Descriptions of new species of XIPHISTER and APODICHTHYS, from Monterey, California. Ibid., vol. 3, pp. 135-140.
1881c Description of two new species of fishes, ASCELICHTHYS RHODORUS and SCYTALINA CERDALE, from Neah Bay, Washington Territory. Ibid., vol. 3, pp. 264-268.
1881d List of the fishes of the Pacific Coast of the United States, with a table showing the distribution of the species. Ibid., vol. 3, pp. 452-458.
1882a Notes on the fishes of the Pacific Coast of the United States. Ibid., vol. 4, pp. 29-70.
1882b Synopsis of the fishes of North America. Bull. U.S. Nat. Mus., no. 16, lvi+1018 pp.
1883 Description of a new species of ARTEDIUS (ARTEDIUS FENESTRALIS) from Puget Sound. Proc. U.S. Nat. Mus., vol. 5, pp. 577-579.
1899 The fishes of Bering Sea. [In] Fur Seals and Fur-seal Islands of the North Pacific Ocean. Part 3, pp. 433-492, pl. 42-85. Washington.

JORDAN, David Starr, and JOUY, Pierre Louis
1882 Check-list of the duplicates of fishes from the Pacific Coast of North America, distributed by the Smithsonian Institution in behalf of the United States National Museum., 1881. Proc. U.S. Nat. Mus., vol. 4, pp. 1-18.

JORDAN, David Starr, and STARKS, Edwin Chapin
1895 The fishes of Puget Sound. Proc. California Acad. Sci., San Francisco, ser. 2, vol. 5, pp. 785-855, pls. 76-104.
1904 A review of the Cottidae or sculpins found in the waters of Japan. Proc. U.S. Nat. Mus., vol. 27, pp. 231-335, 43 figs.
KINCAID, Trevor
1919 An annotated list of Puget Sound fishes. 51 pp., 114 figs. Olympia.
LAY, G. T., and BENNETT, E. T.
1839 Fishes. [In] The Zoology of Captain Beechey's Voyage.... Pp. 41-75, pls. 15-23. London.
LOCKINGTON, William Neale
1880a Descriptions of new genera and species of fishes from the coast of California. Proc. U.S. Nat. Mus., vol. 2, pp. 326-332.
1880b Report upon the food fishes of San Francisco. Rept. Calif. Comm. Fish. 1878-1879 (1880), Sacramento, pp. 17-58.
1882 Description of a new genus and species of Cottidae. Proc. U.S. Nat. Mus., vol. 4, pp. 141-144.
MacGINITIE, George Eber
1935 Ecological aspects of a California marine estuary. American Midland Naturalist, Notre Dame, Indiana, vol. 16, pp. 629-765, 20 figs.
METZ, Charles William
1912 The fishes of Laguna Beach, California. I. Ann. Rept. Laguna Marine Lab., Pomona College, Claremont, Calif., vol. 1, pp. 19-66, 31 figs., 5 pls.
MILES, Ward R.
1918 Experiments on the behavior of some Puget Sound shore fishes. (Blenniidae.) Publs. Puget Sound Biol. Station, Washington State College, Pullman, vol. 2, pp. 79-94.
OSGOOD, Wilfred Hudson
1901 Natural history of the Queen Charlotte Islands, British Columbia. North American Fauna, U.S. Dept. Agric., Bureau Biol. Survey, vol. 21, pp. 1-50, 5 pls.
PALLAS, Peter Simon
1811 Zoographia Rosso-Asiatica, sistens omnium animalium in extenso Imperio Rossico et adjacentibus maribus observatorum recensionem, domicilia, mores et descriptiones anatomen atque icones plurimorum. Vol. 3, vii+428+cxxv pp. Petropoli.
PHILLIPS, Julius B.
1935 Experiments to determine the feasibility of the use of trammel nets in Monterey Bay. California Fish and Game, Sacramento, vol. 21, pp. 138-148, figs. 45-50.
RENDAHL, Hialmar
1931a Fische aus dem östlichen Siberischen Eismeer und dem Nordpazifik. Arkiv for Zoologi, Stockholm, vol. 22A, no. 10, 81 pp., 7 figs.
1931b Ichthyologische Ergebnisse der schwedischen Kamtchatka-Expedition 1920-1922. Ibid., vol. 22A, no. 18, 76 pp., 6 figs.
RICHARDSON, John
1836 Fauna Boreali-Americana.... Part III. The fish. xv+327 pp., pls. 74-97. London.
RUTTER, Cloudsley
1899 Notes on a collection of tide-pool fishes from Kadiak Island, in Alaska. Bull. U.S. Fish Comm., vol. 18, pp. 189-192, fig.
SCHMIDT, Petr Yulievich [Peter Julius]
1903 Sur les conditions physico-géographiques et la faune de la mer du Japon et de la mer d'Okhotsk. Bull. Imperial Russian Geogr. Soc., St. Petersburg, vol. 38, 1902 (1903), no. 5, pp. 503-532. (Text in Russian.)
SCHMIDT, Peter
1929a A revision of the genus HEMILEPIDOTUS Cuvier (Pisces, Cottidae) and of the allied genera. Annuaire du Musee de l'Acad. des Sciences de l'URSS [Akademiîa nauk SSSR, Zoologicheskiĭ muzeĭ, Ezhegodnik], Leningrad, 1929, pp. 359-369.
1929b On the subfamily Blepsiinae (Pisces, Cottidae) of the Pacific. Comptes Rendus de l'Acad. des Sciences de l'URSS [Akademiîa nauk SSSR], Leningrad, 1929, pp. 394-398.
SCHULTZ, Leonard Peter, and DeLACY, Allan C.
1936a Fishes of the American Northwest.... Second installment. Mid-Pacific Magazine, Honolulu, 1936, pp. 63-78.
1936b Fishes of the American Northwest.... Third installment. Ibid., 1936, pp. 127-142.
SCHULTZ, Leonard Peter, and WELANDER, Arthur W.
1934 The cottoid genus HEMILEPIDOTUS of the North Pacific. Journ. Pan-Pacific Research Institute, Honolulu, vol. 9, no. 2, pp. 5-6.

SMITH, Hugh McCormick
1895 Notes on a reconnoissance of the fisheries of the Pacific Coast of the United States in 1894. Bull. U.S. Fish Comm., vol. 14, pp. 223-288.
SMITH, Rosa
1880 A list of the fishes of San Diego, California. Privately publ. leaflet, 1 p. San Diego.
1885 The fishes of San Diego. A revision of the list of fishes made November 5, 1880. West American Scientist, San Diego, Calif., vol. 1, pp. 45-47.
SNYDER, John Otterbein
1913 Notes on RANZANIA MAKUA Jenkins and other species of fishes of rare occurrence on the California coast. Proc. U.S. Nat. Mus., vol. 44, pp. 455-460, pl. 63.
STARKS, Edwin Chapin
1896a Description of a new genus and species of cottoid fishes from Puget Sound. Proc. Acad. Nat. Sci. Philadelphia. 1895 (1896), pp. 410-412.
1896b List of fishes collected at Port Ludlow, Washington. Proc. California Acad. Sci., San Francisco, ser. 2, vol. 6, pp. 549-562, pls. 74-75.
1911 Results of an ichthyological survey about the San Juan Islands, Washington. Ann. Carnegie Mus., Pittsburgh, vol. 7, pp. 162-213, pls. 29-31.
STARKS, Edwin Chapin and MANN, William M.
1911 New and rare fishes from Southern California. Univ. California Publs. Zool., Berkeley, vol. 8, pp. 9-19, 2 figs.
STARKS, Edwin Chapin, and MORRIS, Earl Leonard
1907 The marine fishes of Southern California. Ibid., vol. 3, pp. 159-251, pl. 21.
STEINDACHNER, Franz
1877 Über einige seltene oder neue Fischarten von der Westküste der nordlichen Theile Nordamerika's. Sitzb. k. Akad. Wissensch., Wien, vol. 74, Abth. 1, pp. 128-154, pls. 4, 5, 14.
STREETS, Thomas Hale
1877 Contributions to the natural history of the Hawaiian and Fanning Islands and Lower California, made in connection with the United States North Pacific Surveying Expedition, 1873-1875. Bull. U.S. Nat. Mus., no. 7, 172 pp.
SUCKLEY, George
1860 Report upon the fishes collected on the survey. [In] Report upon the exploration and survey to ascertain the most practical and economical route for a railroad from the Mississippi River to the Pacific Ocean. Vol. 12, book 2, Zool. Rept., no. 5, chap. 1, pp. 307-368, 21 pls. War Dept., Washington.
SWAINSON, William
1839 The Natural History and Classification of Fishes, Amphibians, and Reptiles, or Monocardian Animals. Vol. 2, vi+448 pp., 135 figs. London.
TILESIUS von TILENAU, Wilhelm Gottlieb
1810 Piscum Kamtschaticorum "Teerpuck" et "Wachnja" descriptiones et icones. Mem. Acad. Sci. St. Petersburg, vol. 3, pp. 225-285.
TOWNSEND, Charles Haskins, and NICHOLS, John Treadwell.
1925 Deep sea fishes of the 'Albatross' Lower California Expedition. Bull. American Mus. Nat. Hist., New York, vol. 52, pp. 1-20, 4 figs., 4 pls.
ULREY, Albert B.
1929 A check-list of the fishes of Southern California and Lower California. Journ. Pan-Pacific Research Institute, Honolulu, vol. 4, no. 4, pp. 2-11.
ULREY, Albert B., and GREELEY, Paul Orson
1928 A list of the marine fishes (Teleostei) of Southern California with their distribution. Bull. Southern California Acad. Sci., Los Angeles, vol. 27, pp. 1-53, 3 maps.
WALES, Joseph Howe
1932 Report on two collections of Lower California marine fishes. Copeia, 1932, no. 4, pp. 163-168.
WALFORD, Lionel Albert
1931 Handbook of common commercial and game fishes of California. Fish Bull. no. 28, California Division Fish & Game, Sacramento, 181 pp., 137 figs.
YARROW, Harry Crécy, and HENSHAW, Henry Wetherbee
1878 List of marine fishes collected on the coast of California, near Santa Barbara, in 1875, with notes. Annual Rept. U.S. Geogr. Survey West of 100th Meridian, 1878, pp. 201-205.

Figure 1. *Scorpaenichthys marmoratus* Girard. Drawn by Rolf L. Bolin. See page 6.

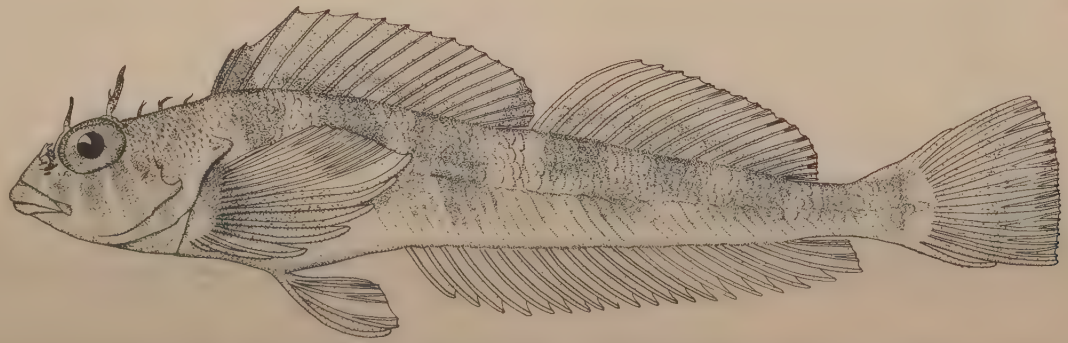

Figure 2. *Jordania zonope* Starks. Drawn by Rolf L. Bolin. See page 9.

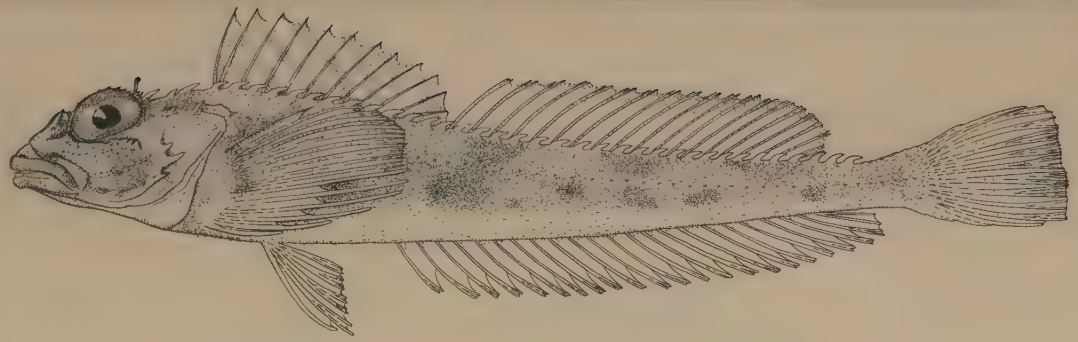

Figure 3. *Paricelinus hopliticus* Eigenmann and Eigenmann. Drawn by Rolf L. Bolin. See page 11.

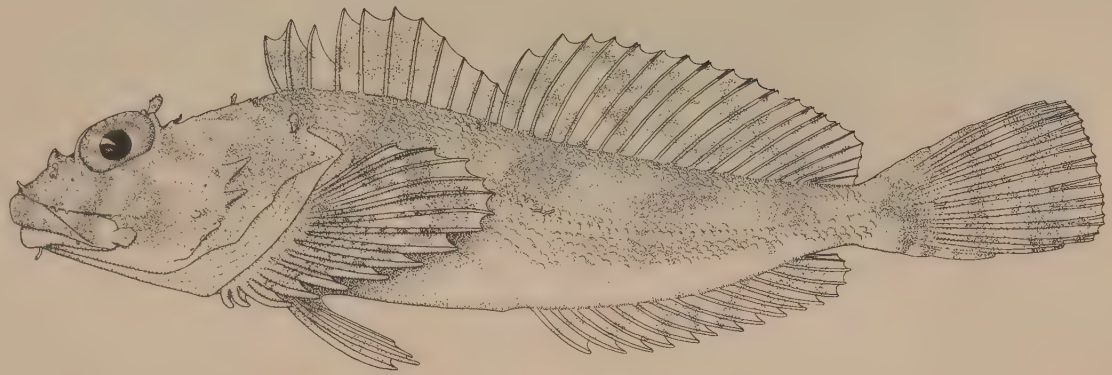

Figure 4. *Hemilepidotus spinosus* (Ayres). Drawn by Rolf L. Bolin. See page 15.

Figure 5. *Hemilepidotus hemilepidotus* (Tilesius). Drawn by Rolf L. Bolin. See page 17.

Figure 6. *Chitonotus pugetensis* (Steindachner). ♂ Drawn by Walter B. Schwarz. See page 19.

Figure 7. *Icelinus filamentosus* Gilbert. Drawn by Rolf L. Bolin. See page 24.

Figure 8. *Icelinus tenuis* Gilbert. Drawn by Walter B. Schwarz. See page 26.

Figure 9. *Icelinus cavifrons* Gilbert. ♀ Drawn by Walter B. Schwarz. See page 28.

Figure 10. *Icelinus burchami* Evermann and Goldsborough. Drawn by Walter B. Schwarz. See page 30.

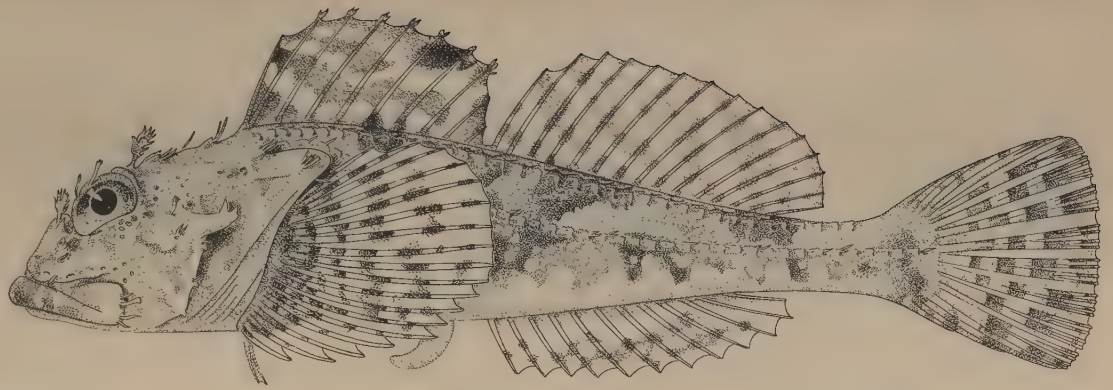

Figure 11. *Icelinus fimbriatus* Gilbert. ♂ Drawn by Walter B. Schwarz. See page 32.

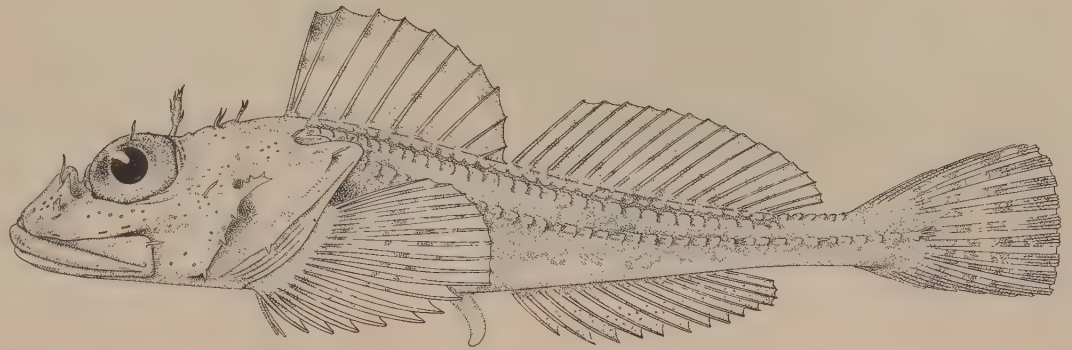

Figure 12. *Icelinus oculatus* Gilbert. ♂ Drawn by Walter B. Schwarz. See page 33.

Figure 13. *Icelinus quadriseriatus* (Lockington). Drawn by Rolf L. Bolin. See page 35.

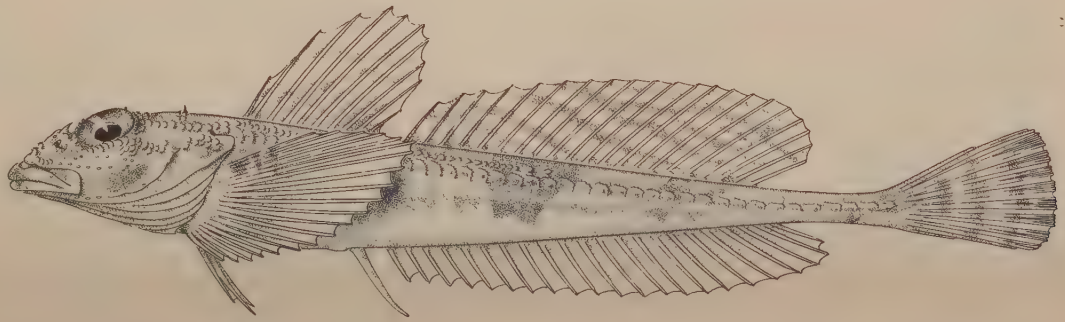

Figure 14. *Radulinus boleoides* Gilbert. ♂ Drawn by Walter B. Schwarz. See page 38.

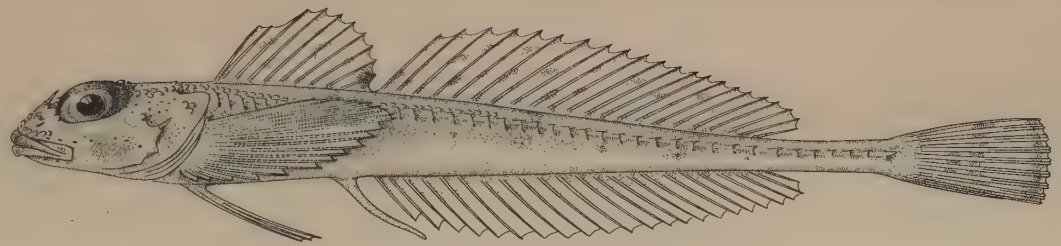

Figure 15. *Radulinus asprellus* Gilbert. ♂ Drawn by Walter B. Schwarz. See page 40.

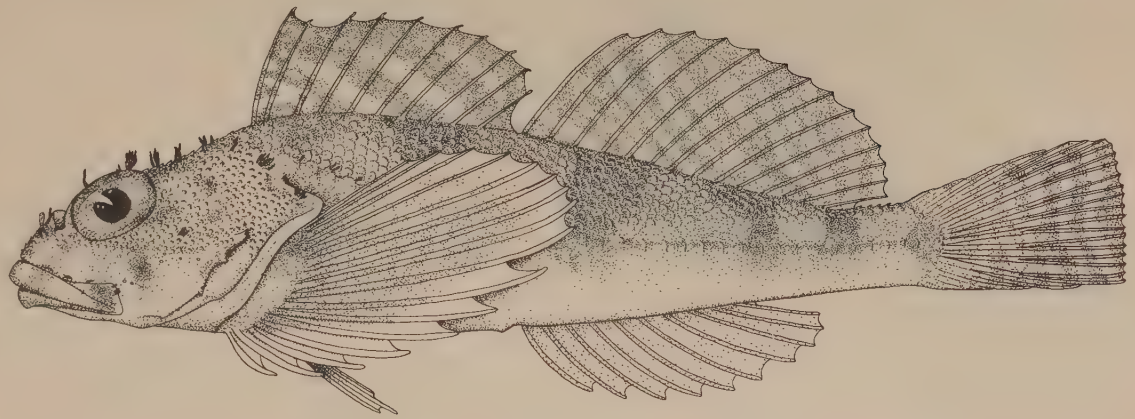

Figure 16. *Artedius creaseri* (Hubbs). Drawn by Rolf L. Bolin. See page 43.

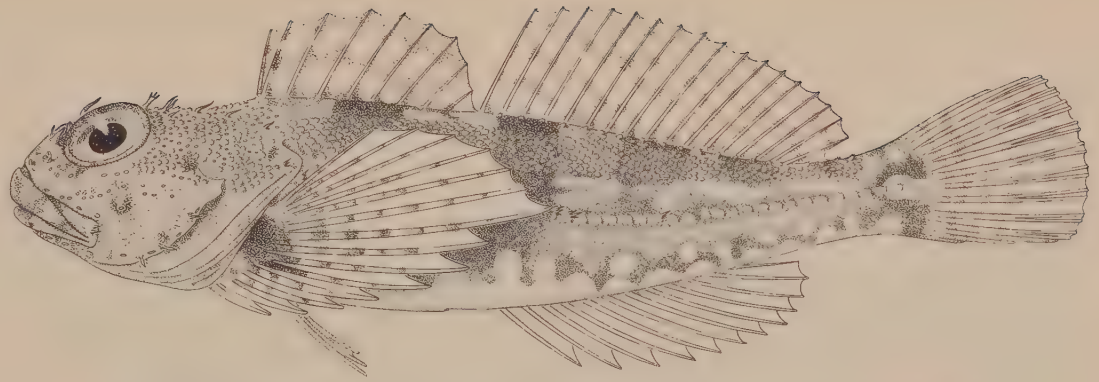

Figure 17. *Artedius harringtoni* (Starks). Drawn by Walter B. Schwarz. See page 45.

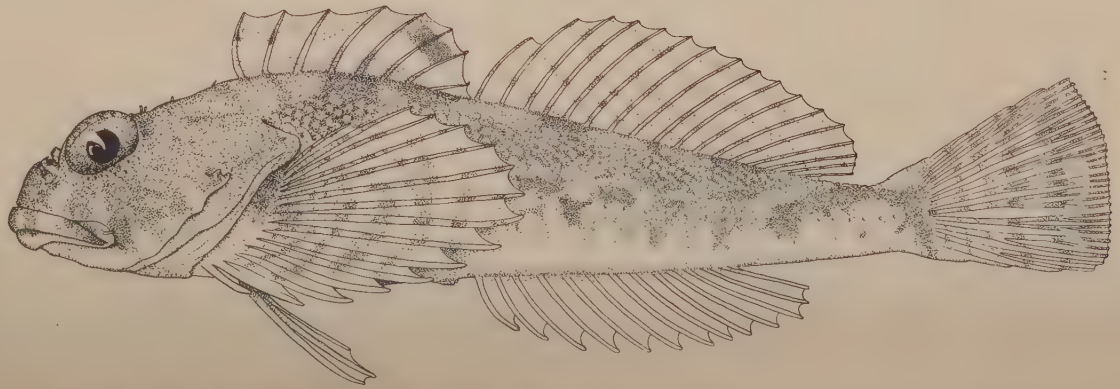

Figure 18. *Artedius fenestralis* (Jordan and Gilbert). Drawn by Rolf L. Bolin. See page 48.

Figure 19. *Artedius notospilotus* Girard. Drawn by Rolf L. Bolin. See page 50.

Figure 20. *Artedius corallinus* (Hubbs). Drawn by Rolf L. Bolin. See page 53.

Figure 21. *Artedius lateralis* (Girard). Drawn by Walter B. Schwarz. See page 55.

Figure 22. *Artedius hankinsoni* (Hubbs). Drawn by Rolf L. Bolin. See page 57.

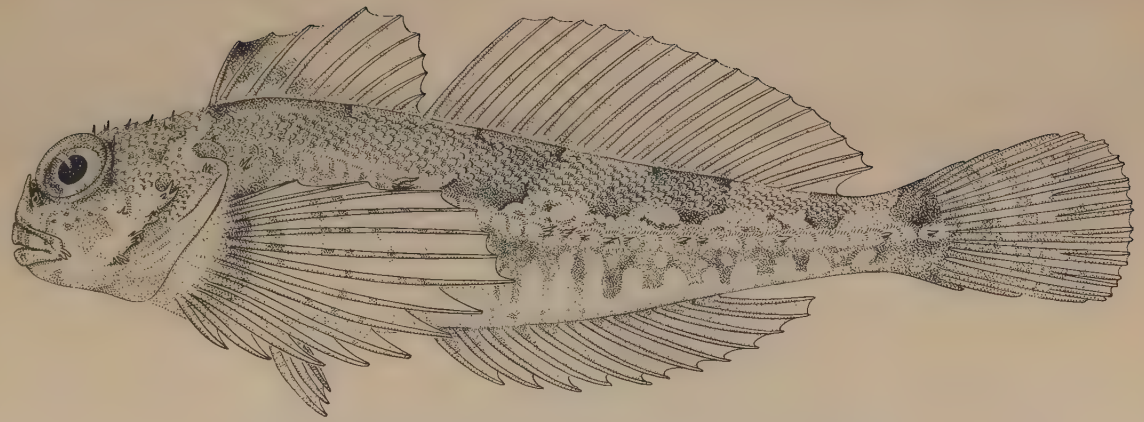

Figure 23. *Orthonopias triacis* Starks and Mann. Drawn by Walter B. Schwarz. See page 59.

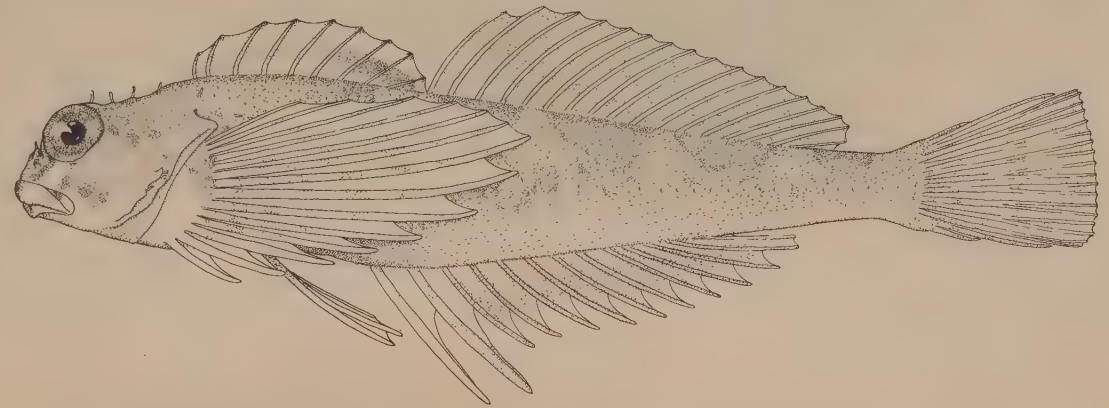

Figure 24. *Oligocottus rimensis* (Greeley). ♂ Drawn by Rolf L. Bolin. See page 63.

Figure 25. *Oligocottus maculosus* Girard. ♂ Drawn by Rolf L. Bolin. See page 65.

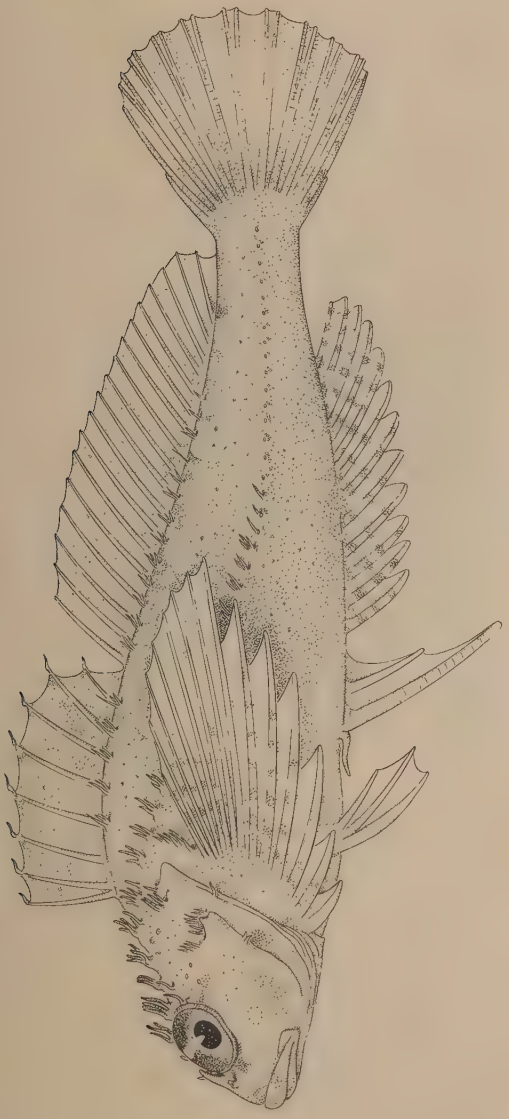

Figure 26. *Oligocottus snyderi* Greeley. ♂ Drawn by Walter B. Schwarz. See page 67.

Figure 27. *Oligocottus rubellio* (Greeley). ♂ Drawn by Rolf L. Bolin. See page 70.

Figure 28. *Clinocottus analis* (Girard). ♂ Drawn by Rolf L. Bolin. See page 73.

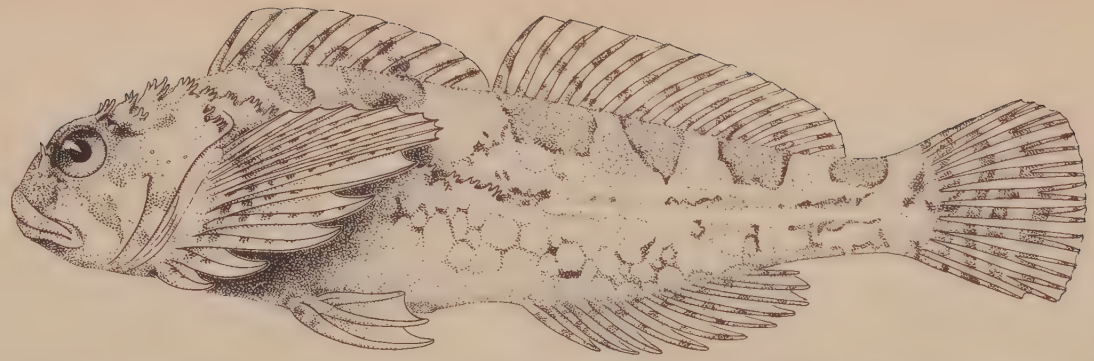

Figure 29. *Clinocottus embryum* (Jordan and Starks). ♀ Drawn by Walter B. Schwarz. See page 78.

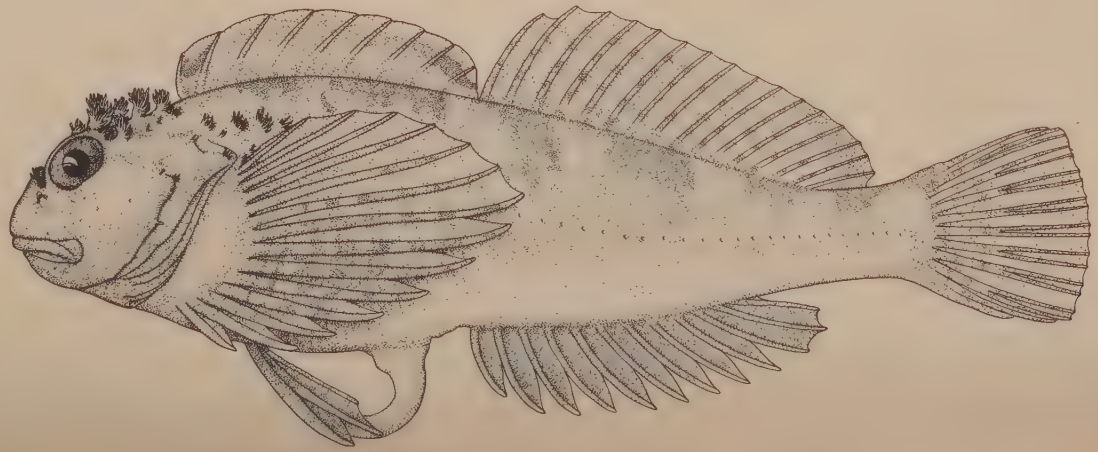

Figure 30. *Clinocottus recalvus* (Greeley). ♂ Drawn by Rolf L. Bolin. See page 79.

Figure 31. *Clinocottus globiceps* (Girard). ♂ Drawn by Walter B. Schwarz. See page 81.

Figure 32. *Clinocottus acuticeps* (Gilbert). ♂ Drawn by Rolf L. Bolin. See page 84.

Figure 33. *Leiocottus hirundo* Girard. ♂ Drawn by Rolf L. Bolin. See page 86.

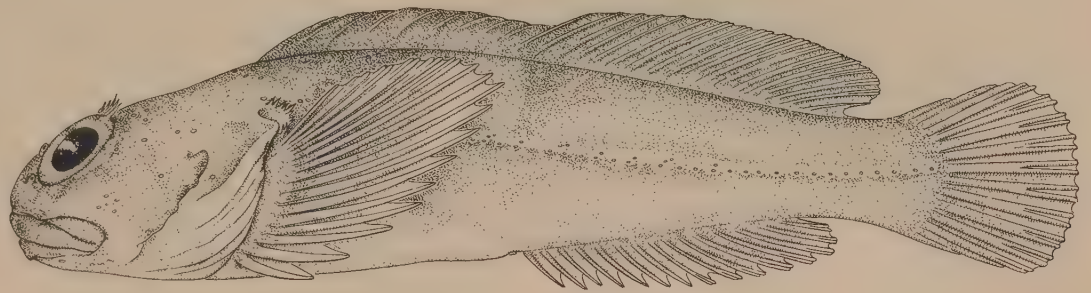

Figure 34. *Ascelichthys rhodorus* Jordan and Gilbert. Drawn by Walter B. Schwarz. See page 88.

Figure 35. *Enophrys bison* (Girard). Drawn by Walter B. Schwarz. See page 91.

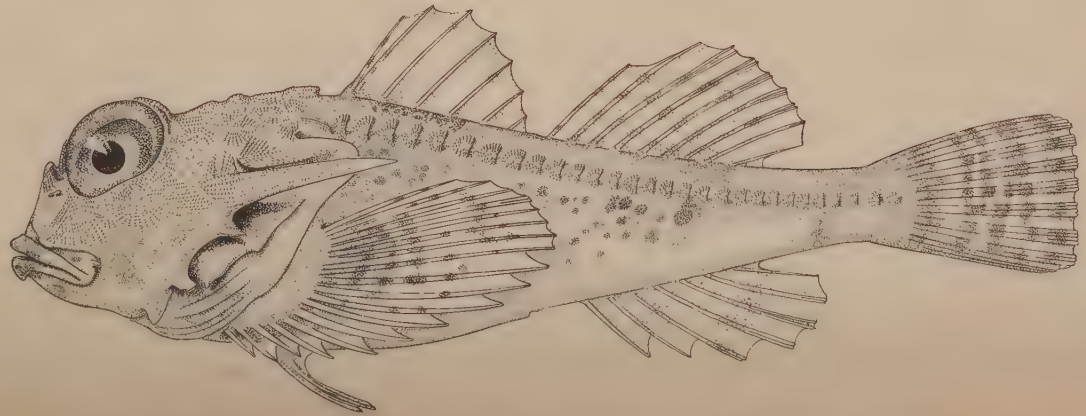

Figure 36. *Enophrys taurinus* Gilbert. Drawn by Walter B. Schwarz. See page 93.

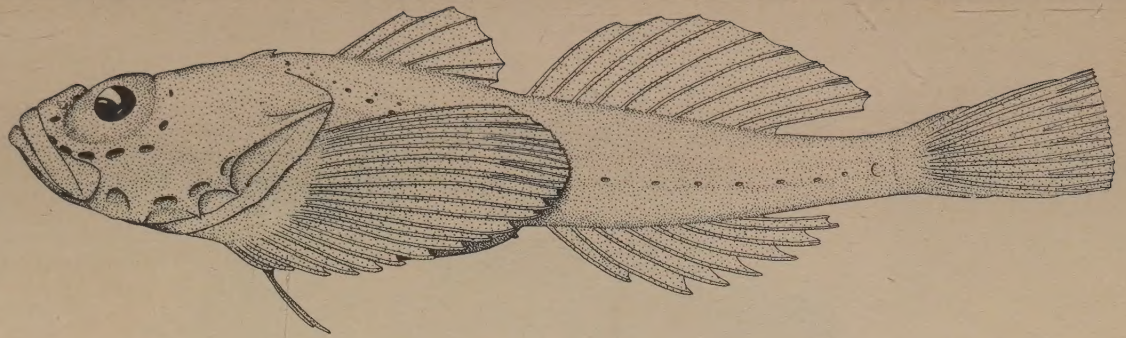

Figure 37. *Zesticelus profundorum* (Gilbert). Drawn by Rolf L. Bolin. See page 95.

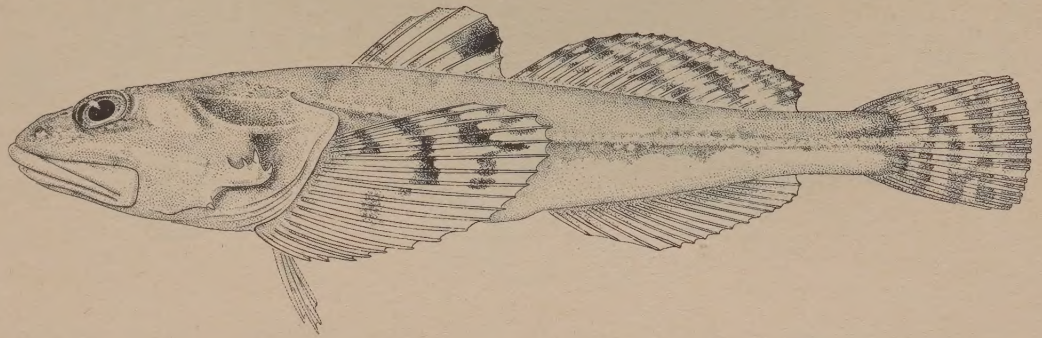

Figure 38. *Leptocottus armatus* Girard. Drawn by Walter B. Schwarz. See page 97.

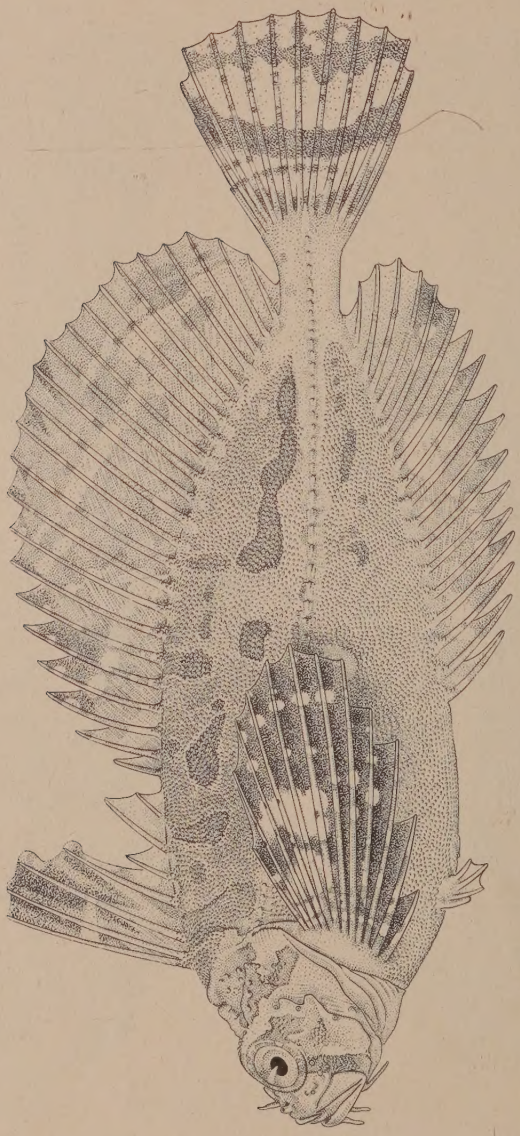

Figure 39. *Blepsias cirrhosus* (Pallas). Drawn by Walter B. Schwarz. See page 99.

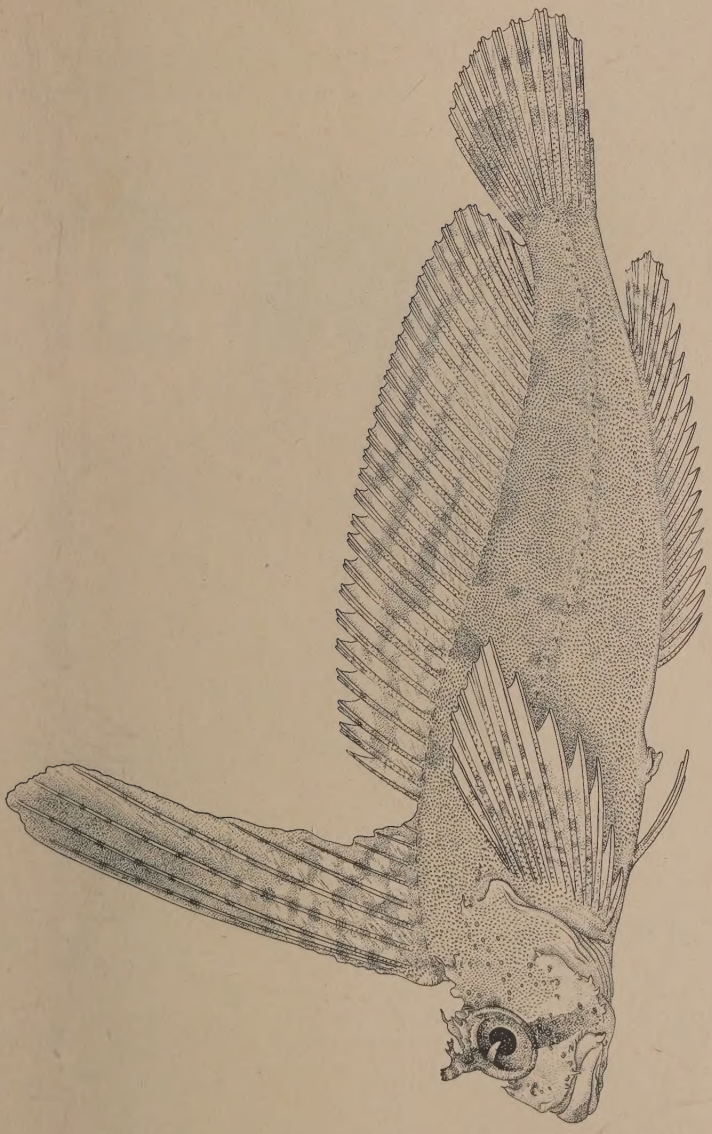

Figure 40. *Nautichthys oculo-fasciatus* (Girard). ♀ Drawn by Walter B. Schwarz. See page 102.